



## 50 to 600 Watts Autoranging, AC-DC Switchers

## Features &amp; Benefits

- RoHS compliant (VE versions)
- Microcontroller architecture
- Inputs: 115/230 Vac autoranging
- Meets FCC Part 15, EN55022, Class B conducted emissions
- 80 – 90% efficiency
- Any output: 1 to 95V<sub>DC</sub>
- Module enable/disable (except LU series)
- UL, TÜV, CE marked
- Remote sense and current limit
- BUS OK and AC OK (except LU series)
- 40ms ride-through time
- OVP and thermal shutdown
- 1 output; up to 200W
- 1 or 2 outputs; up to 400W
- 1, 2, or 3 outputs; up to 600W

## Product Highlights

If you're looking for the convenience of a complete, low-profile, agency-approved switching power supply, look no further. The FlatPAC combines the Vicor workhorse VI-200 family of DC-DC converters with a modular package and front-end subassembly to provide from 50 to 600W of output power from one to three outputs.

A flat plate heat sink for use in conduction cooled applications may be specified as an alternate to the standard finned version by adding "CC" to the end of the model number.

The Vicor FlatPAC is also available with a current controlled output using BatMod converter modules of 12, 24, or 48V<sub>DC</sub> outputs. This option is specified by appending "BM" or "BC" (for conduction cooled versions) to the end of the FlatPAC model number.

Mixing VI-200 and BatMods in a single FlatPAC is not permissible.

The FlatPAC's contemporary design allows us to configure your order quickly and provide rapid turnaround on standard models. It is truly a complete power solution, enabling you to spend more time designing your system and less time worrying about how to power it.

## Configuration Chart

| Typical Model: VI-RU 011-EUUU-:::                  |                                                                                                                 |                                                                                     |                                                  |
|----------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|--------------------------------------------------|
| <b>Input</b><br>115/230 Vac                        | <b>Output</b><br>1: 5 V <sub>DC</sub> at 200W<br>2: 12 V <sub>DC</sub> at 200W<br>3: 12 V <sub>DC</sub> at 200W | <b>Input Characteristics</b><br><b>90–132/180–264 Vac</b><br><b>U</b> = Autoranging |                                                  |
| Substitute VE– for VI– for RoHS compliant versions |                                                                                                                 |                                                                                     |                                                  |
| Configuration                                      | Total Power                                                                                                     | # of Converters                                                                     | Dimensions                                       |
| <b>Single Output</b>                               |                                                                                                                 |                                                                                     |                                                  |
| VI-LU □ - □ □ □                                    | 50 – 200W                                                                                                       | 1                                                                                   | 9.25" x 2.5" x 1.37"<br>(234,8 x 124,5 x 34,8mm) |
| VI-MU □ - □ □ □                                    | 200 – 400W                                                                                                      | 2                                                                                   | 9.25" x 4.9" x 1.37"<br>(234,8 x 124,5 x 34,8mm) |
| VI-NU □ - □ □ □                                    | 300 – 600W                                                                                                      | 3                                                                                   | 9.25" x 7.3" x 1.37"<br>(234,8 x 185,4 x 34,8mm) |
| <b>Dual Output</b>                                 |                                                                                                                 |                                                                                     |                                                  |
| VI-PU □ □ - □ □ □ □                                | 100 – 400W                                                                                                      | 2                                                                                   | 9.25" x 4.9" x 1.37"<br>(234,8 x 124,5 x 34,8mm) |
| VI-QU □ □ - □ □ □ □                                | 150 – 600W                                                                                                      | 3                                                                                   | 9.25" x 7.3" x 1.37"<br>(234,8 x 185,4 x 34,8mm) |
| <b>Triple Output</b>                               |                                                                                                                 |                                                                                     |                                                  |
| VI-RU □ □ □ - □ □ □ □ □                            | 150 – 600W                                                                                                      | 3                                                                                   | 9.25" x 7.3" 1.37"<br>(234,8 x 185,4 x 34,8mm)   |

## Output Voltage

|          |          |           |           |         |         |
|----------|----------|-----------|-----------|---------|---------|
| Z = 2V   | W = 5.5V | M = 10V   | N = 18.5V | K = 40V | D = 85V |
| Y = 3.3V | V = 5.8V | 1 = 12V   | 3 = 24V   | 4 = 48V | B = 95V |
| O = 5V   | T = 6.5V | P = 13.8V | L = 28V   | H = 52V |         |
| X = 5.2V | R = 7.5V | 2 = 15V   | J = 36V   | F = 72V |         |

## Product Grade Temps. °C

| Grade | Operating  | Storage     |
|-------|------------|-------------|
| E =   | 0 to +85   | -20 to +100 |
| C =   | 0 to +85   | -20 to +100 |
| I =   | -30 to +85 | -55 to +100 |

Temperatures apply to product case.

## Output Power/Current

| V <sub>OUT</sub> ≥ 5V | V <sub>OUT</sub> < 5V |
|-----------------------|-----------------------|
| Y = 50W               | Y = 10A               |
| X = 75W               | X = 15A               |
| W = 100W              | W = 20A               |
| V = 150W              | V = 30A               |
| U = 200W              | U = 40A               |

## Output Power/Current

| V <sub>OUT</sub> ≥ 5V | V <sub>OUT</sub> < 5V |
|-----------------------|-----------------------|
| W = 100W              | W = 20A               |
| V = 150W              | V = 30A               |
| U = 200W              | U = 40A               |
| S = 300W              | S = 60A               |
| Q = 400W              | Q = 80A               |

## Output Power/Current

| V <sub>OUT</sub> ≥ 5V | V <sub>OUT</sub> < 5V |
|-----------------------|-----------------------|
| S = 300W              | S = 60A               |
| P = 450W              | P = 90A               |
| M = 600W              | M = 120A              |

## Options

|                               |             |                        |
|-------------------------------|-------------|------------------------|
| BC = BatMod/Conduction Cooled | BM = BatMod | CC = Conduction Cooled |
|-------------------------------|-------------|------------------------|

Note: Product images may not highlight current product markings and cosmetic features.

## Specifications

(typical at 25°C, nominal line and 75% load, unless otherwise specified)

## INPUT SPECIFICATIONS

| Parameter                                                                    | Min | Typ                | Max  | Unit            | Notes                         |
|------------------------------------------------------------------------------|-----|--------------------|------|-----------------|-------------------------------|
| AC line input                                                                |     |                    |      |                 |                               |
| Autoranging                                                                  |     | 90 – 132/180 – 264 |      | Vac             |                               |
| Line frequency                                                               |     | 47 – 63            |      | Hz              | (C-Grade and E-Grade)         |
|                                                                              |     | 47 – 440           |      | Hz              | (I-Grade)                     |
| Inrush current: 115 Vac operation:                                           |     |                    |      |                 |                               |
| 1 converter                                                                  |     | 16                 |      | A               | @ peak line                   |
| 2 converters                                                                 |     | 23                 |      | A               | @ peak line                   |
| 3 converters                                                                 |     | 39                 |      | A               | @ peak line                   |
| Inrush current: 230 Vac operation                                            |     |                    |      |                 |                               |
| 1 converter                                                                  |     | 32                 |      | A               | @ peak line                   |
| 2 converters                                                                 |     | 47                 |      | A               | @ peak line                   |
| 3 converters                                                                 |     | 78                 |      | A               | @ peak line                   |
| Ride-through time (full load)                                                |     |                    |      |                 |                               |
| 90/180 Vac low line                                                          |     | 5                  |      | ms              | minimum                       |
| 115/230 Vac nominal line                                                     |     | 40                 |      | ms              | minimum                       |
| AC fail warning time                                                         |     | 5                  |      | ms              | minimum (low line, full load) |
| AC and BUS OK (2 and 3 converter models only)                                |     |                    |      |                 |                               |
| Off state – Vce                                                              |     |                    | 70   | V               |                               |
| On state – Vcesat                                                            |     |                    | 0.4  | V               | @ 1mA (1.5mA max.)            |
| Module disable (2 and 3 converter models only, optically isolated LED input) |     |                    |      |                 |                               |
| Continuous forward current                                                   |     | 1 – 30             |      | mA              |                               |
| Forward voltage                                                              |     |                    | 1.65 | V               | @ 30mA                        |
| Dielectric withstand                                                         |     |                    |      |                 |                               |
| Primary to chassis GND                                                       |     | 2,121              |      | V <sub>DC</sub> |                               |
| Primary to secondary                                                         |     | 4,242              |      | V <sub>DC</sub> |                               |
| Secondary to chassis GND                                                     |     | 707                |      | V <sub>DC</sub> |                               |

## OUTPUT SPECIFICATIONS

| Parameter                              | E-Grade |      |       | C-, I-Grade |       |       | Unit             | Notes                          |
|----------------------------------------|---------|------|-------|-------------|-------|-------|------------------|--------------------------------|
|                                        | Min     | Typ  | Max   | Min         | Typ   | Max   |                  |                                |
| Set point accuracy                     |         | 1%   | 2%    |             | 0.5%  | 1%    | V <sub>NOM</sub> |                                |
| Load/line regulation                   |         |      | 0.5%  |             | 0.05% | 0.2%  | V <sub>NOM</sub> | LL to HL, 10% to Full Load     |
|                                        |         |      | 1%    |             | 0.2%  | 0.5%  | V <sub>NOM</sub> | LL to HL, No Load to full load |
| Output temperature drift               |         | 0.02 |       |             | 0.01  | 0.02  | %/°C             | Over rated temperature         |
| Long term drift                        |         | 0.02 |       |             | 0.02  |       | %/1k hours       |                                |
| Output ripple                          |         |      |       |             |       |       |                  |                                |
| 2V                                     |         |      | 150mV |             | 60mV  | 100mV | p-p              | 20MHz bandwidth                |
| 5V                                     |         |      | 5%    |             | 2%    | 3%    | p-p              | 20MHz bandwidth                |
| 10 – 48V                               |         |      | 3%    |             | 0.75% | 1.5%  | p-p              | 20MHz bandwidth                |
| Output voltage trimming <sup>[a]</sup> | 50%     |      | 110%  | 50%         |       | 110%  |                  |                                |
| Total remote sense compensation        | 0.5     |      |       | 0.5         |       |       | Volts            | 0.25V max. neg. leg            |
| OVP set point                          |         | 125% |       | 115%        | 125%  | 135%  | V <sub>NOM</sub> | Recycle power                  |
| Current limit                          | 105%    |      | 135%  | 105%        |       | 125%  | I <sub>NOM</sub> | Automatic restart              |
| Short circuit current <sup>[b]</sup>   | 20%     |      | 140%  | 20%         |       | 130%  | I <sub>NOM</sub> |                                |

## Specifications (Cont.)

## THERMAL CHARACTERISTICS

| Parameter              | E-Grade |          |     | C-, I- Grade |          |     | Units | Test Conditions                   |
|------------------------|---------|----------|-----|--------------|----------|-----|-------|-----------------------------------|
|                        | Min     | Typ      | Max | Min          | Typ      | Max |       |                                   |
| Efficiency             |         | 78 – 88% |     |              | 80 – 90% |     |       | @ 5V and higher                   |
| Shut down temp. — case | 90      | 95       | 105 | 90           | 95       | 105 | °C    | Cool and recycle power to restart |
| Operating temp. — case |         |          | 85  |              |          | 85  | °C    | See Thermal Curves                |

## MECHANICAL SPECIFICATIONS

| Parameter             | E-Grade |               |     | C-, I- Grade |               |     | Units             | Test Conditions |
|-----------------------|---------|---------------|-----|--------------|---------------|-----|-------------------|-----------------|
|                       | Min     | Typ           | Max | Min          | Typ           | Max |                   |                 |
| Weight <sup>[c]</sup> |         | 22.4<br>(652) |     |              | 22.4<br>(652) |     | Ounces<br>(Grams) |                 |

## AGENCY APPROVALS

| Safety Standards            | Markings           | Notes                 |
|-----------------------------|--------------------|-----------------------|
| UL1604, UL60950-1           | cURus              |                       |
| UL / CSA / EN / IEC 60950-1 | cTÜVus,<br>CE Mark | Low Voltage Directive |

## EMI / EMC Characteristics

(Performed on selected samples representative of the U Series FlatPac product family.)

| Parameter                               | Notes                                                              |
|-----------------------------------------|--------------------------------------------------------------------|
| Conducted emissions, LISN               | EN 55022 and FCC R&R, Part 15, Subpart B, Class B                  |
| Radiated emissions, 10 meters           | EN 55022; 1998 and FCC R&R, Part 15, Subpart B, Class A            |
| Electrostatic discharge                 | IEC 61000-4-2: 1995, Level 4; ±8kV Contact, ± 15kV Air Discharge   |
| RF radiated immunity, E-field           | IEC 61000-4-3: 1997; 80MHz to 1.0GHz, 3V/M, CW                     |
| Electrical fast transients/burst        | EN 61000-4-4: 1995, Level 3; ±2kV,                                 |
| Surge immunity                          | EN 61000-4-5: 1996 Class 3; ±2kV Line to Ground, ±1kV Line to Line |
| RF conducted immunity                   | IEC 61000-4-6: 1996, class 3, 10V <sub>RMS</sub> , 150kHz to 80MHz |
| Power frequency magnetic field immunity | IEC 61000-4-8: 1994, 30 to 300 A/M, 50Hz                           |
| Voltage dips and interrupts             | IEC 61000-4-11: 1994                                               |

<sup>[a]</sup> 10V to 15V outputs, trim range ± 10%. Consult factory for wider trim range.

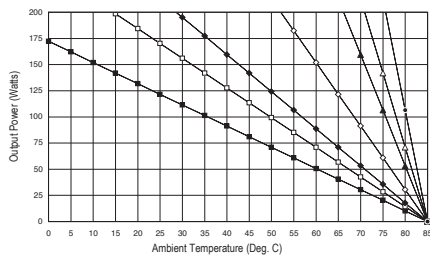
<sup>[b]</sup> Output voltages of 5V or less incorporate foldback current limiting, outputs greater than 5V incorporate straight line current limiting.

<sup>[c]</sup> For MU, PU series, multiply value by 2; for NU, QU, RU series, multiply value by 3.

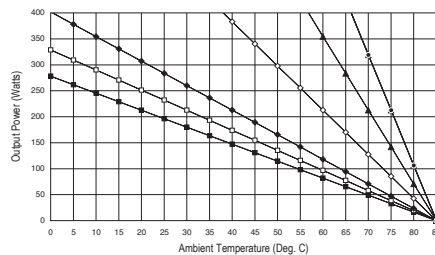
## Thermal Curves

—■— FREE AIR    —□— 50LFM    —◆— 100LFM    —◇— 250LFM    —▲— 500LFM    —△— 750LFM    —●— 1000LFM

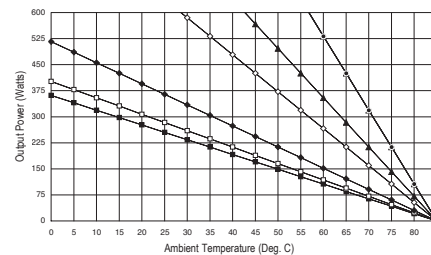
## 5V Output



LU Series

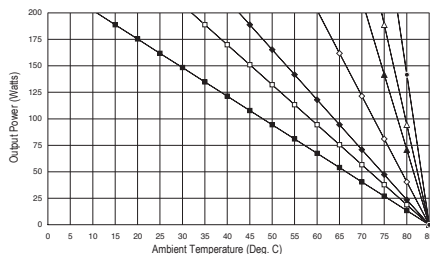


MU, PU Series

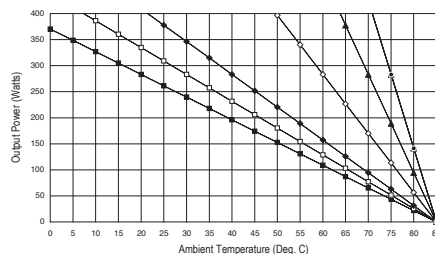


NU, QU, RU Series

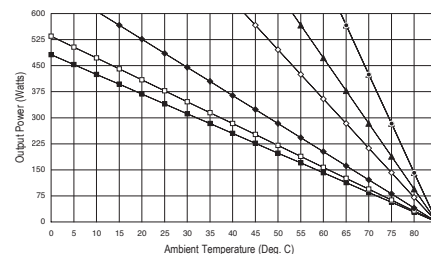
## 10 to 48V Output



LU Series

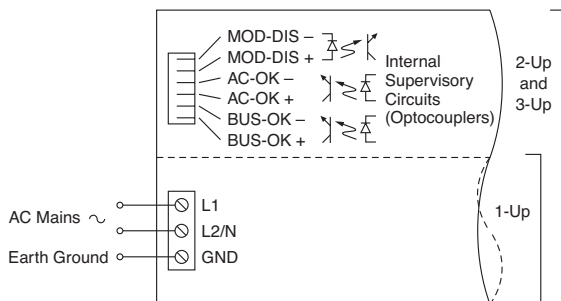


MU, PU Series

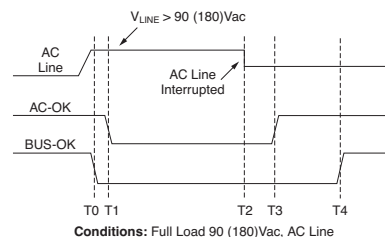


NU, QU, RU Series

## Application Circuits

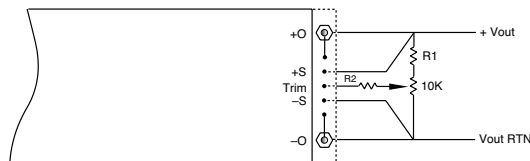


AC Mains Connections



| Time Interval | Min | Typ | Max | Units | Notes                |
|---------------|-----|-----|-----|-------|----------------------|
| T0-T1         | 0   | 0.1 | 1.0 | ms    |                      |
| T2-T3         | 0   | 40  | —   | ms    | Ride-through time    |
| T2-T4         | 5   | —   | —   | ms    | Hold-up time         |
| T3-T4         | 5   | —   | —   | ms    | AC fail warning time |

## Power Up and Power Down Sequencing



## Resistor Values for Trimming Standard Output Voltages

| Nom. Output Voltage | 5V    | 12V  | 15V  | 24V  | 28V  | 48V  | Trim Range |
|---------------------|-------|------|------|------|------|------|------------|
| R1(kΩ)              | 0.953 | 15.8 | 22.1 | 41.2 | 48.7 | 90.9 | +10%, -10% |
| R2(kΩ)              | 90    | 90   | 90   | 90   | 90   | 90   |            |

## Output Trimming

## Mechanical Drawings

### Inputs

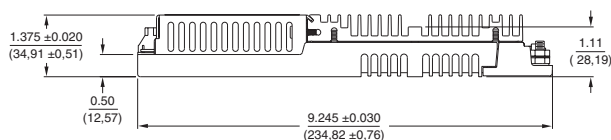
- 1 MOD DIS-
  - 2 MOD DIS+
  - 3 AC OK-
  - 4 AC OK+
  - 5 BUS OK-
  - 6 BUS OK+
  - 7 AC IN L1
  - 8 AC IN L2/N
  - 9 CHASSIS GND
- Input connector,  
TE Connectivity P/N 644488-6;  
mating connector
- Terminals for  
#16-12 AWG wire

### Outputs

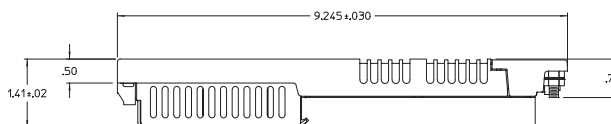
- 10 +OUT (#10-32 Stud)
  - 11 +OUT
  - 12 +SENSE ( $V_{TRIM}^*$ )
  - 13 TRIM ( $I_{TRIM}^*$ )
  - 14 -SENSE ( $I_{MON}^*$ )
  - 15 -OUT
  - 16 -OUT (#10-32 Stud)
- Output connector,  
TE Connectivity P/N 644486-5;  
mating connector

\*On FlatPACs with BatMODs only.

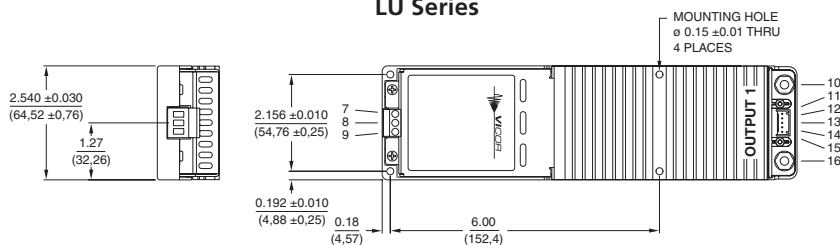
### STANDARD Models



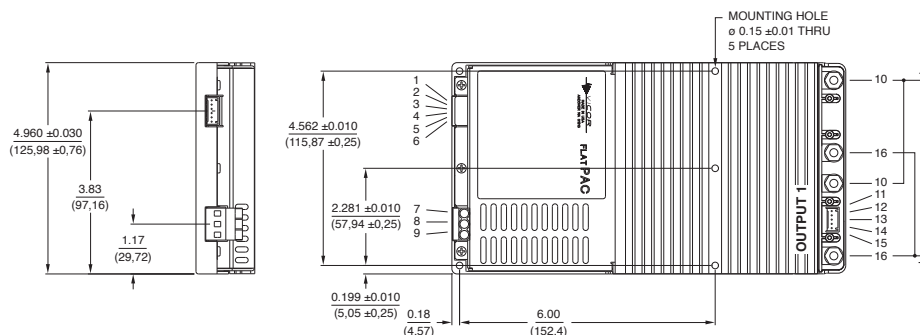
### CONDUCTION COOLED Models "-CC"



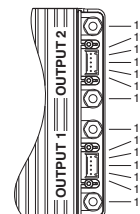
### LU Series



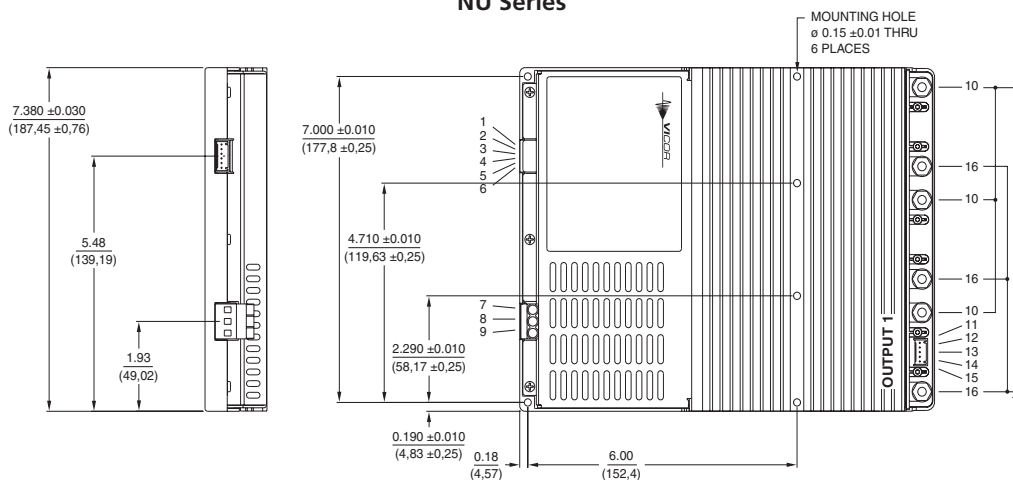
### MU Series



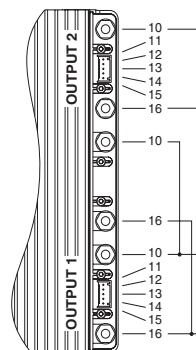
### PU Series



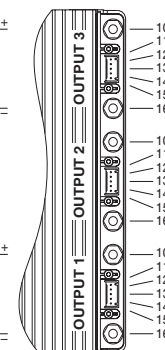
### NU Series



### QU Series



### RU Series



**Vicor's comprehensive line of power solutions includes high density AC-DC and DC-DC modules and accessory components, fully configurable AC-DC and DC-DC power supplies, and complete custom power systems.**

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[VI-RU1VR-CYYW](#) [VI-RU310-EUXV](#) [VI-PU0L-IYX-CC](#) [VI-QU10-CQU](#) [VI-PUY1-CWW](#) [VI-RUL22-EUYY](#) [VI-RUY01-](#)  
[EYVV](#) [VI-RU001-IWYU](#) [VI-QU01-ESV](#) [VI-QULL-IQY](#) [VI-RU011-EWUU](#) [VI-RU20Y-CXYY](#) [VI-PU2L-EYY](#) [VI-RU330-](#)  
[IVVX](#) [VI-RUL2M-IWUY-CC](#) [VI-QU32-CQY](#) [VI-RU000-CWWW-LL](#) [VI-PU01-EYY-LL](#) [VI-PU10-CUU](#) [VI-RUZ00-IWXX](#)  
[VI-RU013-CYUV](#) [VI-RU023-IYVV](#) [VI-RU314-CUYW](#) [VI-RU310-EVWY](#) [VI-RU022-EXYY](#) [VI-RU013-CYYV](#) [VI-RU011-](#)  
[EUXW](#) [VI-RU1HH-EVVV](#) [VI-PU0Y-IUY](#) [VI-PUYZ-EYY](#) [VI-PUZZ-CUU](#) [VI-RU213-CVYW](#) [VI-RU442-EVYV](#) [VI-PU2M-](#)  
[CWY](#) [VI-RU00Z-CUVX](#) [VI-PU04-IYY](#) [VI-QULN-IQU](#)