TECHNICAL REFERENCE NOTE

# ARTESYN CNS650-M SERIES

650 Watts (forced air)
400 Watts (convection)

## PRODUCT DESCRIPTION

Advanced Energy's Artesyn CNS650-MU series of single output open-frame AC-DC power supplies are offered in 12 V, 24 V, or 48 V outputs with +15% Trim range. Each power supply comes with a 12 V fan output and 5 V standby. All models feature ITE and medical safety approvals and accept a universal input of 90 to 264 Vac. Depending on operating conditions, its 4 x 6 x 1.54 in compact and high density "U-Channel" Construction delivers up to 400 watts of output power with free air convection cooling and up to 650 watts with 400 LFM of forced air. These power supplies are ideal for industrial systems as well as for medical applications.

### AT A GLANCE

**Total Power**

400 to 650 Watts

**Input Voltage**

90 to 264 Vac

**# of Outputs**

Main, Standby and Fan

RoHS

80 PLUS PLATINUM INDUSTRIAL

## SPECIAL FEATURES

- Designed for forced air and natural convection cooling
- Medical and ITE safety approvals, 2x MOPP
- PMBus™ interface
- Active current share with OR-ing FET
- Dual fused
- Type BF ready
- Active Power Factor Correction, 61000-3-2 compliant
- Built-in Class B EMI filter
- Less than 1U high
- 4" x 6" U-channel construction (open-frame or end-fan variants available for 12V)
- <500 mW no-load power consumption
- 80 PLUS certified (-ME model)
- Three-year warranty (consult factory for extended terms)

## SAFETY

- UL/CSA ES60601-1/C22.2 No. 60601-1 UL/CSA 62368-1
- TÜV EN 60601-1
- DEMKO EN 62368-1
- CB IEC 60601-1 IEC 62368-1
- CCC GB4943.1/GB9254; GB17625.1
- CE Mark
- UKCA Mark

** CNS650-M tested according to the medical standard IEC 60601-1 3.1 Edition.

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## MODEL NUMBERS

| Standard | Output Voltage | Minimum Load | Maximum Load (Convection) | Peak Load (Convection)[1] | Maximum Load (Forced Air)[2] | Peak Load (Forced Air)[2] | Standby[6] |
|---|---|---|---|---|---|---|---|
| CNS653-MU[3] | 12.0Vdc | 0A | 33.3A | 54.2A | 54.2A | 62.5A | 5Vdc@2A |
| CNS653-ME[4,7] | 12.0Vdc | 0A | 54.2A | 62.5A | NA | NA | 5Vdc@2A |
| CNS653-MF[5] | 12.0Vdc | 0A | 30.8A | 54.2A | 54.2A | 62.5A | 5Vdc@2A |
| CNS655-MU | 24.0Vdc | 0A | 16.7A | 27.1A | 27.1A | 31.3A | 5Vdc@2A |
| CNS658-MU | 48.0Vdc | 0A | 8.3A | 13.5A | 13.5A | 15.6A | 5Vdc@2A |

Note 1 - Peak load current not to exceed 10 seconds.
Note 2 - Requires at least 400 LFM of airflow.
Note 3 - “MU” for U-Channel construction.
Note 4 - “ME” for built-in End-Fan with cover and IEC inlet.
Note 5 - “MF” for Open Frame construction.
Note 6 - 2A with forced air cooling or 1A at natural convection.
Note 7 - 80 PLUS Certified.
Note 8 - 12Vdc Fan voltage supply available via connector J306 or J304 (pins 9 & 11). Rated 1A with forced air or 0.5A at natural convection.

### Options

None

# ELECTRICAL SPECIFICATIONS

## Absolute Maximum Ratings

Stress in excess of those listed in the "Absolute Maximum Ratings" may cause permanent damage to the power supply. These are stress ratings only and functional operation of the unit is not implied at these or any other conditions above those given in the operational sections of this TRN. Exposure to any absolute maximum rated condition for extended periods may adversely affect the power supply's reliability.

**Table 1. Absolute Maximum Ratings**

| Parameter | Model | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Input Voltage<br>AC continuous operation | All models | $V_{IN,AC}$ | 90 | - | 264 | Vac |
| Maximum Output Power (Main + Stand-by) | All models | $P_{O,max}$ | - | - | 650 | W |
| Isolation Voltage<br>Input to Output<br>Input to Earth Ground<br>Output to Earth Ground | <br>All models<br>All models<br>All models | | <br>-<br>-<br>- | <br>-<br>-<br>- | <br>4,000<br>1,500<br>1,500 | <br>Vac<br>Vac<br>Vac |
| Production Hi-pot<br>Input to Output for 3 sec<br>Input to Earth Ground for 3 sec<br>Output to Earth Ground for 3 sec | <br>All models<br>All models<br>All models | | <br>-<br>-<br>- | <br>-<br>-<br>- | <br>1,800<br>1,500<br>264 | <br>Vac<br>Vac<br>Vac |
| Ambient Operating Temperature | All models | $T_A$ | -20 | - | +80[1] | $^{O}$C |
| Startup Temperature | All models | $T_{startup}$ | -40 | - | - | $^{O}$C |
| Storage Temperature | All models | $T_{STG}$ | -40 | - | +85 | $^{O}$C |
| Relative Humidity (non-condensing)<br>Operating<br>Non-operating | <br>All models<br>All models | | <br>5<br>5 | <br>-<br>- | <br>95<br>95 | <br>%<br>% |
| Altitude<br>Operating<br>Non-operating | <br>All models<br>All models | | <br>-10<br>- | <br>-<br>- | <br>5,000[2]<br>10,000 | <br>m<br>m |

Note 1 - No power derating up to 50$^{O}$C, linear derating to 80$^{O}$C.
Note 2 - Operating altitude up to 3,000m for Medical, 5,000m for ITE.

# ELECTRICAL SPECIFICATIONS

## Input Specifications

**Table 2. Input Specifications**

| Parameter | Condition | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Operating Input Voltage | All | $V_{IN,AC}$ | 90 | 115/230 | 264 | Vac |
| | | $V_{IN,DC}$ | 127 | - | 350[1] | Vdc |
| Turn on Input Voltage | All | $V_{IN,AC}$ | - | 87 | 90 | Vac |
| Turn off Input Voltage | All | $V_{IN,AC}$ | 80 | 82 | - | Vdc |
| Input AC Frequency[2] | All | $f_{IN,AC}$ | 47 | 50/60 | 63 | Hz |
| | | | 360 | - | 400 | Hz |
| Maximum Input Current ($I_O = I_{O,max}$, $I_{SB} = I_{SB,max}$) | $V_{IN,AC}$ = 90Vac | $I_{IN,max}$ | - | - | 9.2 | Arms |
| Standby Input Power[3] ($V_O$ = Off, $I_{SB}$ = 0A) | All | $P_{IN,SB}$ | - | - | 0.5 | W |
| No Load Input Power(12V, 24V model) ($V_O$ = On, $I_O$ = 0A, $I_{SB}$ = 0A) | $V_{IN,AC}$ = 90Vac | $P_{IN,\ no\text{-}load}$ | | | 3 | W |
| No Load Input Power(48V model) ($V_O$ = On, $I_O$ = 0A, $I_{SB}$ = 0A) | $V_{IN,AC}$ = 90Vac | $P_{IN,\ no\text{-}load}$ | | | 5 | W |
| Harmonic Line Current | Full Load | THD | - | - | 20 | % |
| Power Factor[4] | 230Vac, Full Load<br>115Vac, Full Load | | 0.95<br>0.98 | -<br>- | -<br>- | |
| Inrush Current @ 25°C | $V_{IN,AC}$ = 264Vac Cold Start | $I_{IN,surge}$ | - | - | 50 | $A_{PK}$ |
| Input Fuse | Both L and N | | - | - | 12 | A |
| Turn On Delay | By AC Mains | | - | - | 2 | S |
| | By Inhibit | | - | - | 1.5 | S |
| Leakage Current | UL test method | | - | - | 300 | uA |
| Efficiency (25degC, Without Standby & Fan) | 230Vac, Full Load | η | 92.5 | 93.0 | - | % |
| | 230Vac, Half Load | η | 92.5 | 93.0 | - | % |
| | 115Vac, Full Load | η | 90.0 | 90.5 | - | % |
| | 115Vac, Half Load | η | 91.0 | 91.5 | - | % |

Note 1 - Tested and characterized up to 400Vdc but safety approved up to 350Vdc only.
Note 2 - Characterized and tested for 360-400Hz operation but not part of safety approval.
Leakage/touch current will be higher and will not meet medical requirements.
Note 3 - To achieve the input power lower than 0.5W, the PMBus communication and all signals are disabled except the inhibit pin.
Note 4 - Rated power factor is for 47 to 63 Hz input frequency only. Power factor will be lower at 360 to 400 Hz input frequency.

# ELECTRICAL SPECIFICATIONS

## Output Specifications

**Table 3. Output Specifications**

| Parameter | | Condition | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| Output Power (Convection, Continuous, Open Frame, "-MF" Suffix) | | $T_A$= 50°C<br>$V_{IN}$=90Vac<br>$V_{IN}$=180Vac | | 0<br>0 | -<br>- | 305<br>370 | W<br>W |
| Output Power (Convection, Continuous, U-Channel, "-MU" Suffix) | | $T_A$= 50°C<br>$V_{IN}$=90Vac<br>$V_{IN}$=180Vac | | 0<br>0 | -<br>- | 345<br>410 | W<br>W |
| Output Power (Forced-Air, Continuous, End Fan, , "-ME" Suffix) | | $T_A$=50°C<br>$V_{IN}$=90-264Vac<br>Air flow=200LFM<br>Air flow=400LFM | | 0<br>0 | -<br>- | 550<br>650 | W<br>W |
| Output Setpoint Voltage (Factory) | CNS653-MX[1]<br>CNS655-MU<br>CNS658-MU | Inclusive of setpoint, temperature change, warm-up drift | $V_O$ | 11.88<br>23.76<br>47.52 | 12.0<br>24.0<br>48.0 | 12.12<br>24.24<br>48.48 | V |
| | All Models | | $V_{Standby}$ | - | 5.0 | - | |
| Output Voltage Adjustability | CNS653-MX<br>CNS655-MU<br>CNS658-MU | % of Setpoint | | 100 | - | 115 | $\%V_O$ |
| Output Ripple, pk-pk | All Models | Measure with a 0.1uF ceramic capacitor in parallel with a 10uF tantalum capacitor, 0 to 20MHz bandwidth | $\%V_O$ | - | - | 1 | % |
| Fan Output Voltage | All Models | | $V_{fan}$ | - | 12 | - | V |
| Fan Output Current (Convection, Continuous) | All Models | | $I_{fan, convection}$ | - | 0.5 | - | A |
| Fan Output Current (Forced-Air, Continuous) | All Models | | $I_{fan, forced-air}$ | - | 1.0 | - | A |
| Line Regulation | All Models | | | -2 | - | 2 | % |
| Load Regulation | All Models | | | -2 | - | 2 | % |
| Standby Output Voltage[2] | All Models | | $V_{SB}$ | - | 5 | - | Vdc |
| Standby Output Current (Convection, Continuous) | All Models | | $I_{O, Standby}$ | 0.06 | 1 | - | A |
| Standby Output Current (Forced-Air, Continuous) | All Models | | $I_{O, Standby}$ | 0.06 | 2 | - | A |
| Minimum Load for Current Sharing | | | | 10 | - | - | $\%I_{O,max}$ |
| Output Current Share Accuracy | | 20% to 100% $I_{O, max}$ | $\%I_{O, max}$ | - | - | 5 | %A |
| I_Share Voltage | | No load | | - | - | 0.5 | Vdc |
| | | 50% load | | 3.85 | 4 | 4.15 | Vdc |
| | | 100% load | | 7.75 | 8 | 8.25 | Vdc |

Note 1 - "MX" means "MU", "ME" and "MF".
Note 2 - If the application will not be using the 5Vsb output, it is recommended to add pre-load at the 5Vsb output to ensure that it will not go into hiccup mode. Suggested preload is 300mW minimum.

# ELECTRICAL SPECIFICATIONS

## Output Specifications

| Table 3. Output Specifications Con't | | | | | | |
|---|---|---|---|---|---|---|
| **Parameter** | **Condition** | **Symbol** | **Min** | **Typ** | **Max** | **Unit** |
| Number of Parallel Units | Main Output Current Share connected | | - | - | 2 | |
| Number of Series Units | External Diodes Required | | - | - | 4 | |
| Output Capacitance | | | 0 | - | 330 | uF/A |
| $V_O$ Dynamic Response<br>Peak Deviation<br>Recovery Time | 50% load change, with capacitive load of 330uF/A | $\pm\%V_O$ | -<br>- | -<br>- | 3<br>500 | %<br>uS |
| MTBF | 25°C, 410W convection | | 9.5 | - | - | $10^5$ hrs |
| | 25°C, 650W forced air | | 13 | - | - | $10^5$ hrs |
| Hold up time | Convection(400W load) | | 20 | 25 | - | ms |
| | Forced Air(650W load) | | 12 | 15 | - | ms |

# ELECTRICAL SPECIFICATIONS

## CNS653-MX Performance Curves

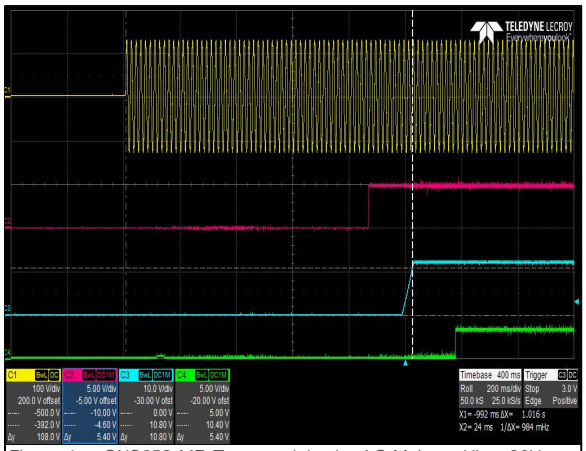


Figure 1: CNS653-ME Turn-on delay by AC Mains – Vin = 90Vac
Load: $I_O$ = 54.2A, $I_{SB}$ = 2A
Ch 1: $V_{IN}$ Ch 2: $V_{SB}$ Ch 3: $V_O$ Ch 4: PWOK

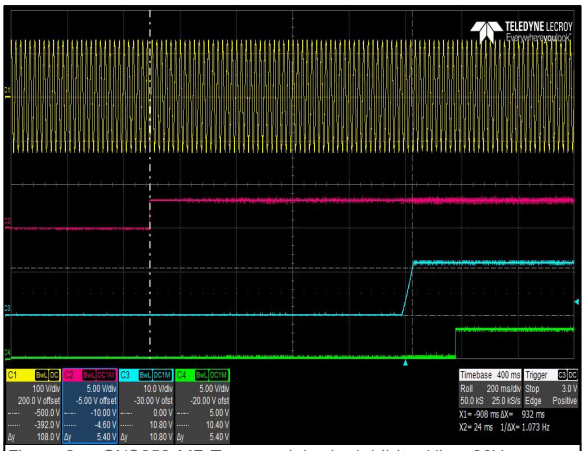


Figure 2: CNS653-ME Turn-on delay by Inhibit – Vin = 90Vac
Load: $I_O$ = 54.2A, $I_{SB}$ = 2A
Ch 1: $V_{IN}$ Ch 2: Inhibit Ch 3: $V_O$ Ch 4: PWOK

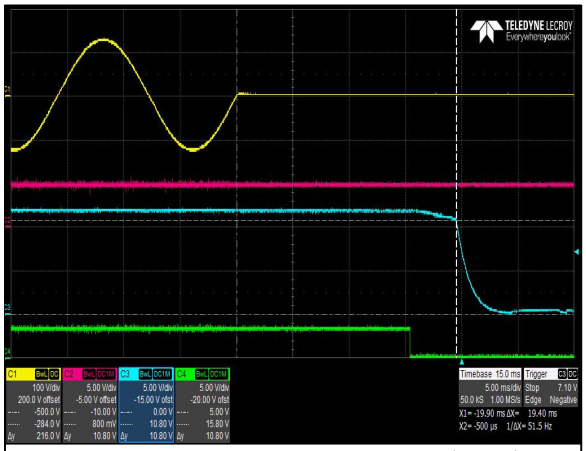


Figure 3: CNS653-ME Hold-up Time – Vin = 90Vac / 63Hz / 0°
Load: $I_O$ = 54.2A, $I_{SB}$ = 2A
Ch 1: $V_{IN}$ Ch 2: $V_{SB}$ Ch 3: $V_O$ Ch 4: PWOK

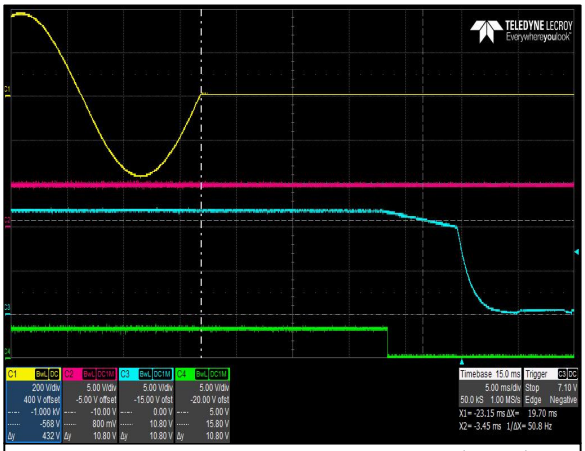


Figure 4: CNS653-ME Hold-up Time – Vin = 264Vac / 47Hz / 0°
Load: $I_O$ = 54.2A, $I_{SB}$ = 2A
Ch 1: $V_{IN}$ Ch 2: $V_{SB}$ Ch 3: $V_O$ Ch 4: PWOK

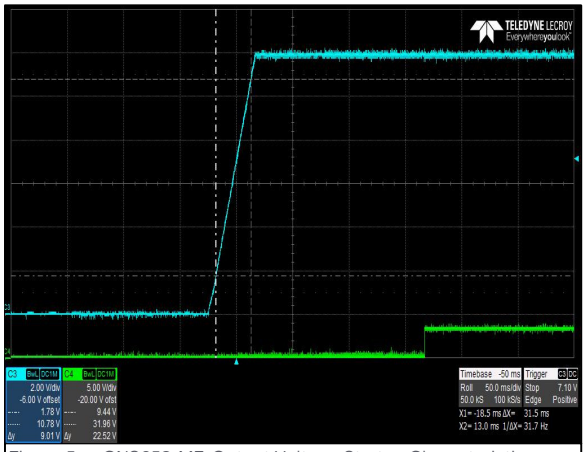


Figure 5: CNS653-ME Output Voltage Startup Characteristic
$V_{IN}$ = 90Vac, Load: $I_O$ = 54.2A
Ch 3: $V_O$ Ch 4: PWOK

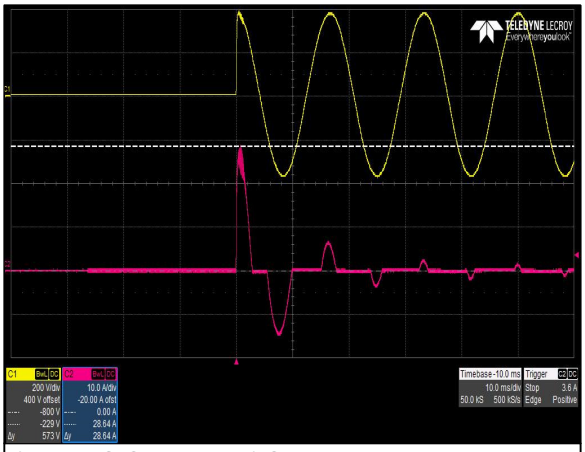


Figure 6: CNS653-ME Inrush Current
$V_{IN}$ = 264Vac, Load: $I_O$ = 0A, Turn on angle = 90°
Ch 1: $V_{IN}$ Ch 2: $I_{IN}$

# ELECTRICAL SPECIFICATIONS

## CNS653-MX Performance Curves

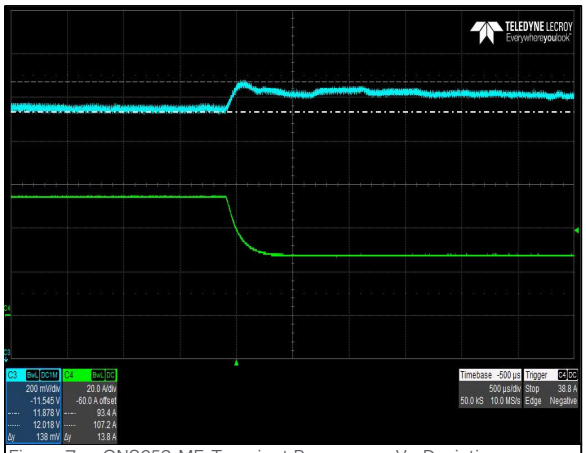



Figure 7: CNS653-ME Transient Response – Vo Deviation
$V_{IN}$ = 90Vac, $I_O$ = 100% to 50%, Output Cap = 330uF/A
Ch 3: $V_O$ Ch 4: $I_O$

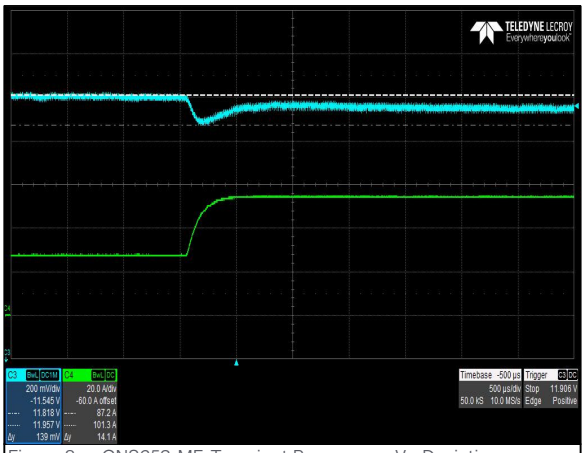



Figure 8: CNS653-ME Transient Response – Vo Deviation
$V_{IN}$ = 90Vac, $I_O$ = 100% to 50%, Output Cap = 330uF/A
Ch 3: $V_O$ Ch 4: $I_O$

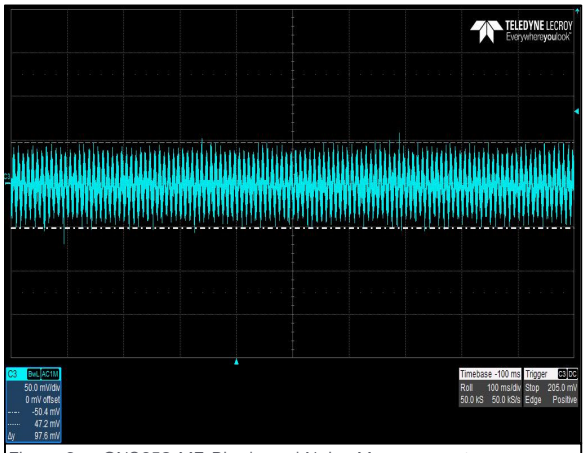



Figure 9: CNS653-ME Ripple and Noise Measurement
$V_{IN}$ = 115Vac, Load: $I_O$ = 54.2A
Ch 3: $V_O$

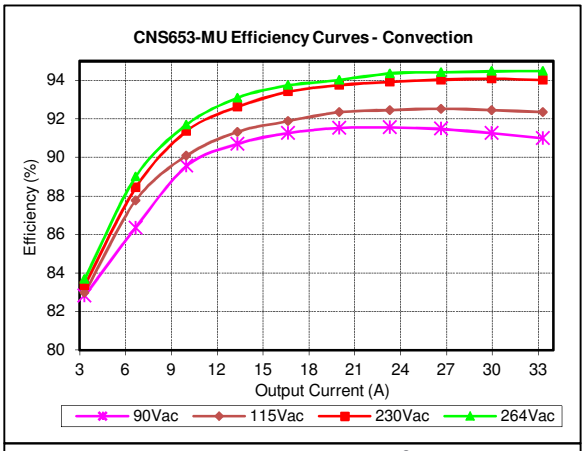



Figure 10: CNS653-MU Efficiency Curves @ 25°C
Convection Cooling
$V_{IN}$ = 90 to 264Vac, Load: $I_O$ = 0 to 33.3A

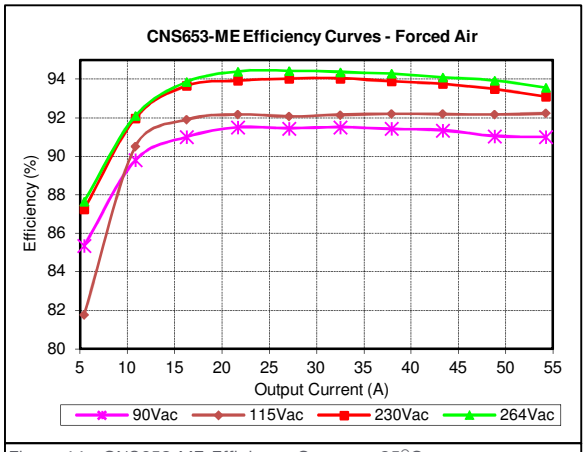



Figure 11: CNS653-ME Efficiency Curves @ 25°C
Forced Air, Internal Fan
$V_{IN}$ = 90 to 264Vac, Load: $I_O$ = 0 to 54.2A

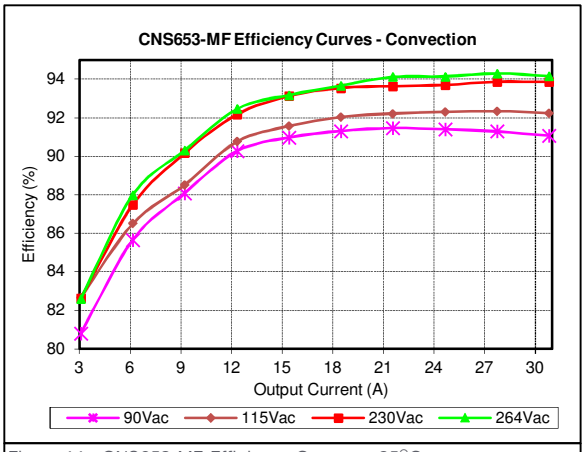



Figure 11: CNS653-MF Efficiency Curves @ 25°C
Convection Cooling
$V_{IN}$ = 90 to 264Vac, Load: $I_O$ = 0 to 30.8A

# ELECTRICAL SPECIFICATIONS

## CNS655-MU Performance Curves

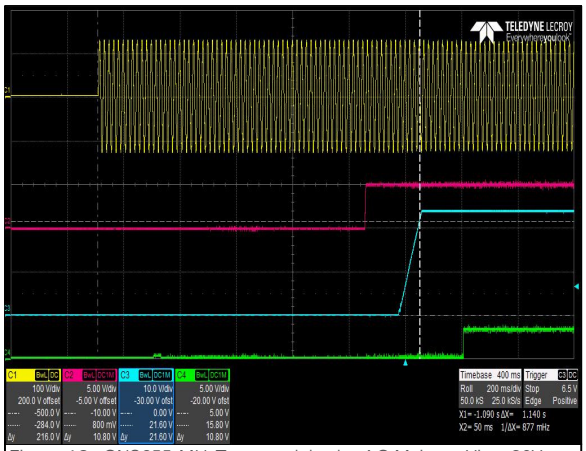


Figure 13: CNS655-MU Turn-on delay by AC Mains – Vin = 90Vac
Load: $I_O$ = 16.7A, $I_{SB}$ = 1A
Ch 1: $V_{IN}$ Ch 2: $V_{SB}$ Ch 3: $V_O$ Ch 4: PWOK

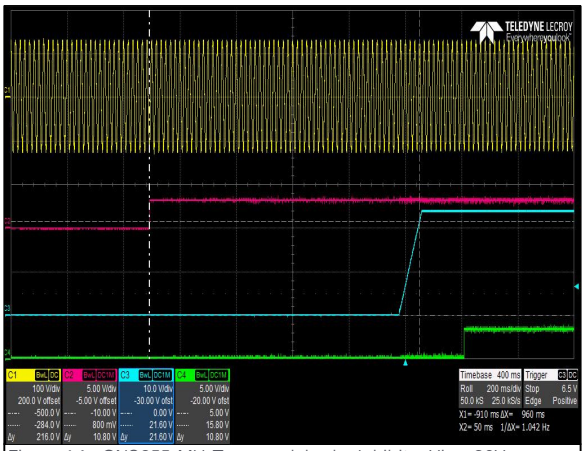


Figure 14: CNS655-MU Turn-on delay by Inhibit – Vin = 90Vac
Load: $I_O$ = 16.7A, $I_{SB}$ = 1A
Ch 1: $V_{IN}$ Ch 2: Inhibit Ch 3: $V_O$ Ch 4: PWOK

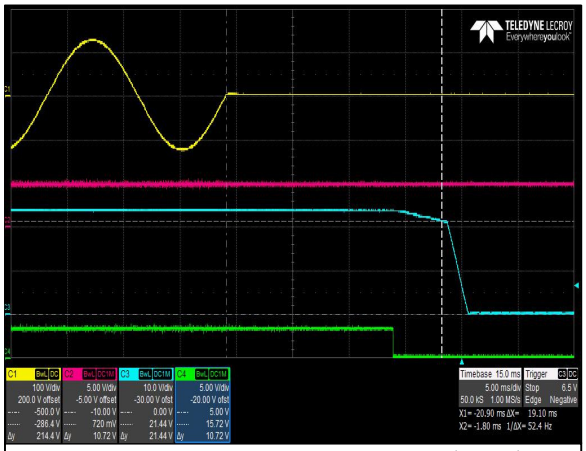


Figure 15: CNS655-MU Hold-up Time – Vin = 90Vac / 63Hz / 0°
Load: $I_O$ = 16.7A, $I_{SB}$ = 1A
Ch 1: $V_{IN}$ Ch 2: $V_{SB}$ Ch 3: $V_O$ Ch 4: PWOK

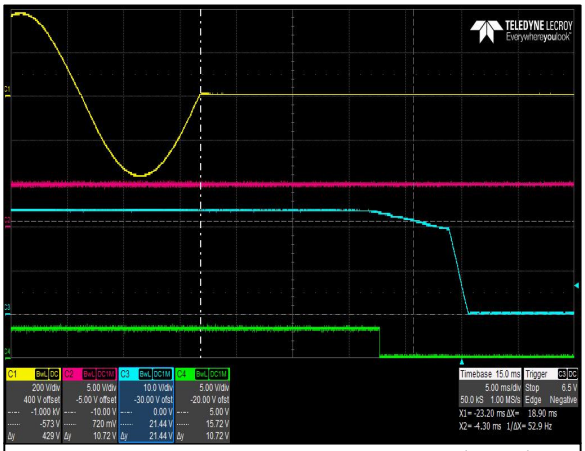


Figure 16: CNS655-MU Hold-up Time – Vin = 264Vac / 47Hz / 0°
Load: $I_O$ = 16.7A, $I_{SB}$ = 1A
Ch 1: $V_{IN}$ Ch 2: $V_{SB}$ Ch 3: $V_O$ Ch 4: PWOK

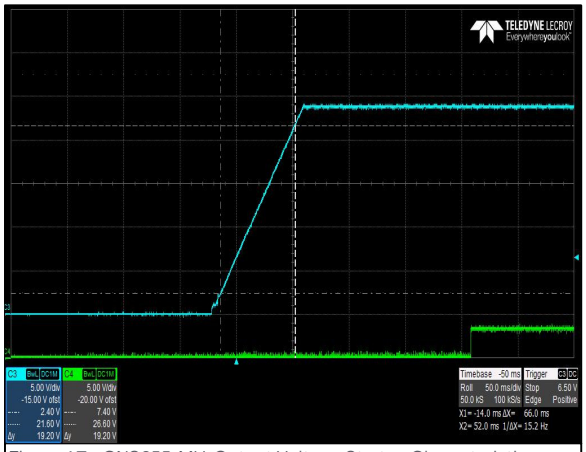


Figure 17: CNS655-MU Output Voltage Startup Characteristic
Vin = 90Vac, Load: $I_O$ = 16.7A
Ch 3: $V_O$ Ch 4: PWOK

Figure 18: CNS655-MU Inrush Current
$V_{IN}$ = 264Vac, Load: $I_O$ = 0A, Turn on angle = 90°
Ch 1: $V_{IN}$ Ch 2: $I_{IN}$

# ELECTRICAL SPECIFICATIONS

## CNS655-MU Performance Curves

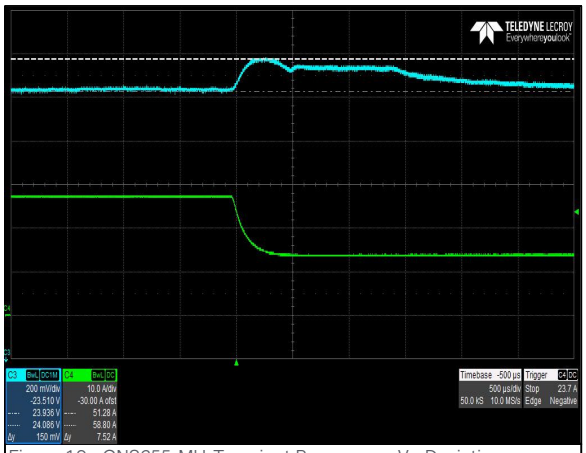



Figure 19: CNS655-MU Transient Response – Vo Deviation
$V_{IN}$ = 90Vac, $I_O$ = 100% to 50%, Output Cap = 330uF/A
Ch 3: $V_O$ Ch 4: $I_O$

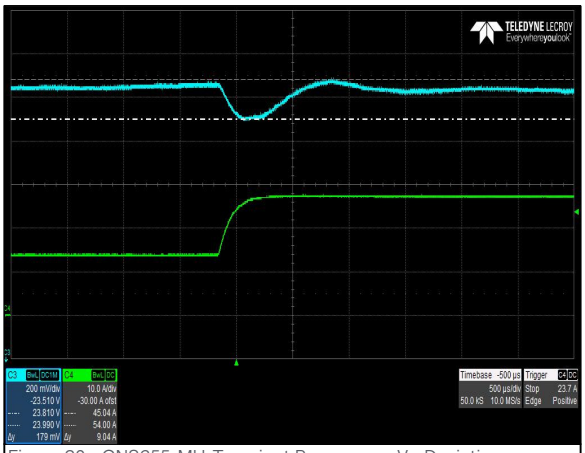



Figure 20: CNS655-MU Transient Response – Vo Deviation
$V_{IN}$ = 90Vac, $I_O$ = 100% to 50%, Output Cap = 330uF/A
Ch 3: $V_O$ Ch 4: $I_O$

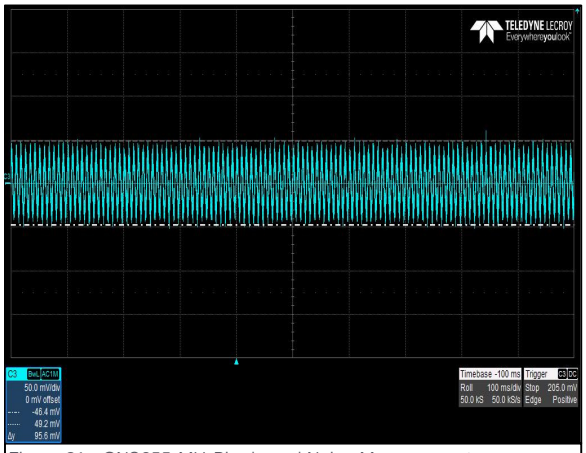



Figure 21: CNS655-MU Ripple and Noise Measurement
Vin = 115Vac, Load: $I_O$ = 16.7A
Ch 3: $V_O$

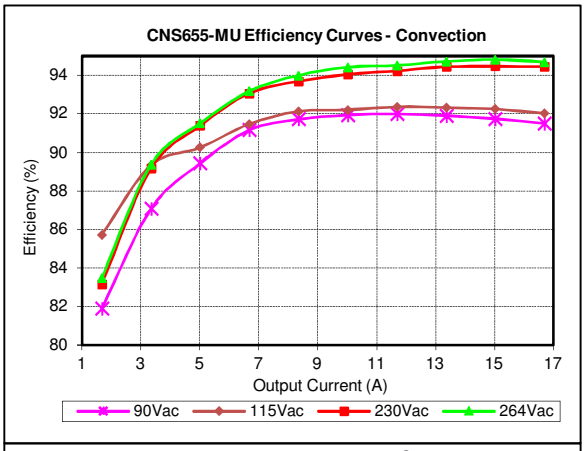



Figure 22: CNS655-MU Efficiency Curves @ 25°C
Convection Cooling
$V_{IN}$ = 90 to 264Vac, Load: $I_O$ = 0 to 16.7A

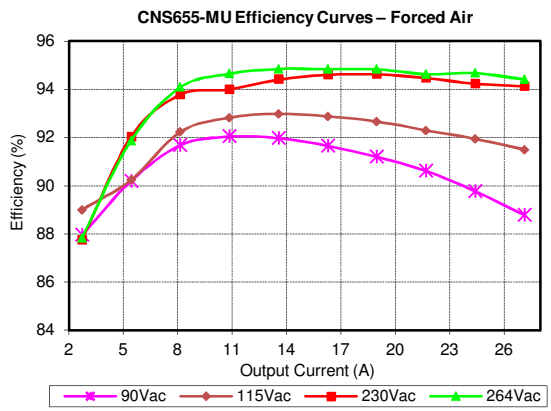



Figure 23: CNS655-MU Efficiency Curves @ 25°C
Forced Air
$V_{IN}$ = 90 to 264Vac, Load: $I_O$ = 0 to 27.1A

# ELECTRICAL SPECIFICATIONS

## CNS658-MU Performance Curves

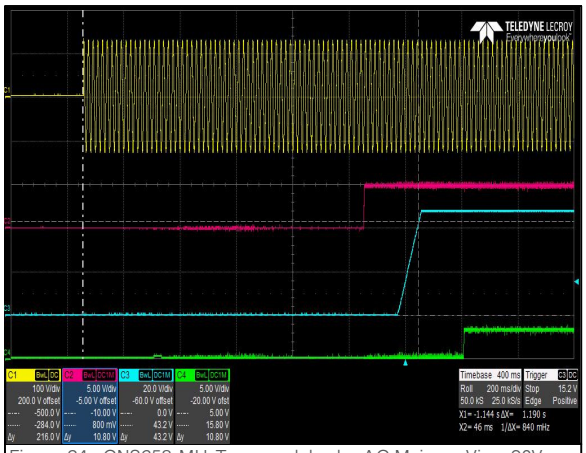



Figure 24: CNS658-MU Turn-on delay by AC Mains – Vin = 90Vac
Load: $I_O$ = 8.3A, $I_{SB}$ = 1A
Ch 1: $V_{IN}$ Ch 2: $V_{SB}$ Ch 3: $V_O$ Ch 4: PWOK

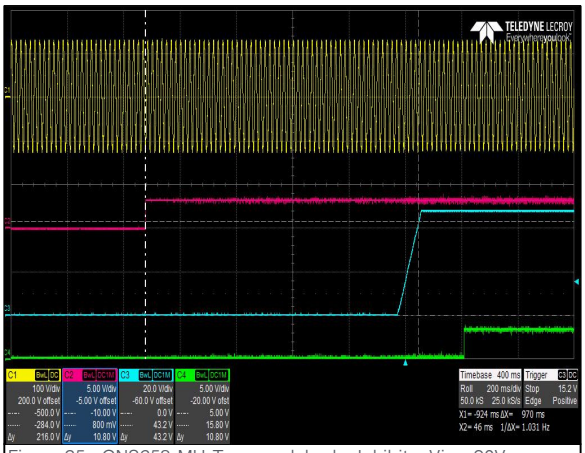



Figure 25: CNS658-MU Turn-on delay by Inhibit – Vin = 90Vac
Load: $I_O$ = 8.3A, $I_{SB}$ = 1A
Ch 1: $V_{IN}$ Ch 2: Inhibit Ch 3: $V_O$ Ch 4: PWOK

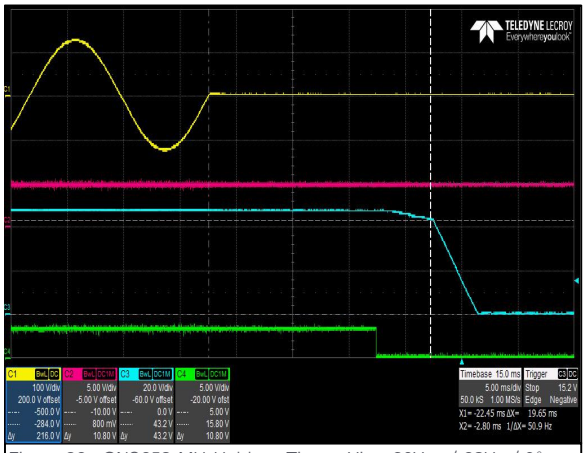



Figure 26: CNS658-MU Hold-up Time – Vin = 90Vac / 63Hz / 0°
Load: $I_O$ = 8.3A, $I_{SB}$ = 1A
Ch 1: $V_{IN}$ Ch 2: $V_{SB}$ Ch 3: $V_O$ Ch 4: PWOK

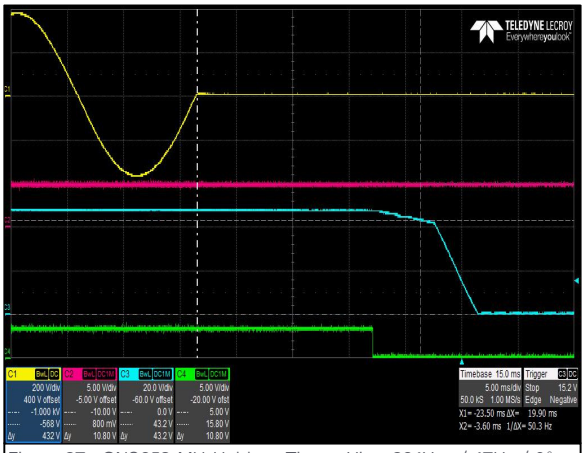



Figure 27: CNS658-MU Hold-up Time – Vin = 264Vac / 47Hz / 0°
Load: $I_O$ = 8.3A, $I_{SB}$ = 1A
Ch 1: $V_{IN}$ Ch 2: $V_{SB}$ Ch 3: $V_O$ Ch 4: PWOK

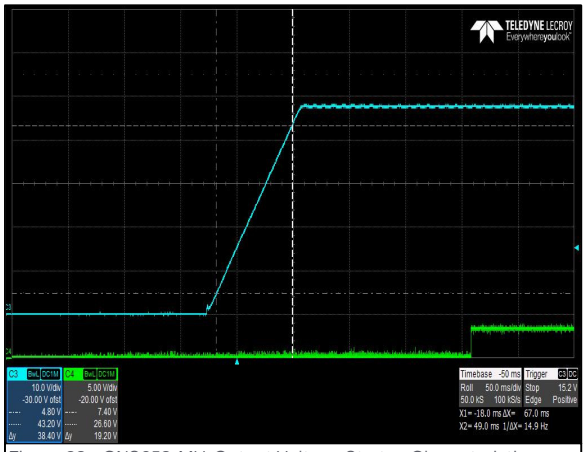



Figure 28: CNS658-MU Output Voltage Startup Characteristic
Vin = 90Vac, Load: $I_O$ = 8.3A
Ch 3: $V_O$ Ch 4: PWOK

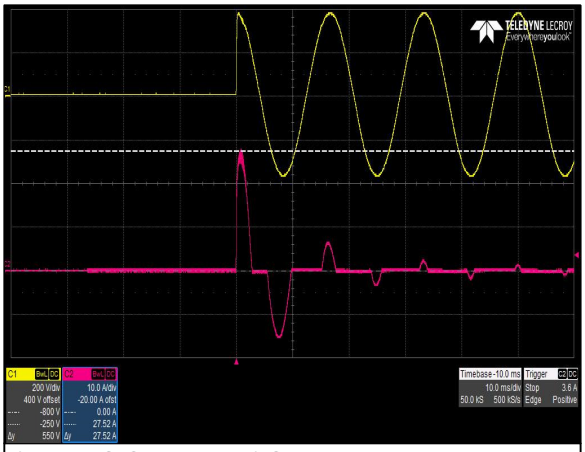



Figure 29: CNS658-MU Inrush Current
$V_{IN}$ = 264Vac, Load: $I_O$ = 0A, Turn on angle = 90°
Ch 1: $V_{IN}$ Ch 2: $I_{IN}$

# ELECTRICAL SPECIFICATIONS

## CNS658-MU Performance Curves

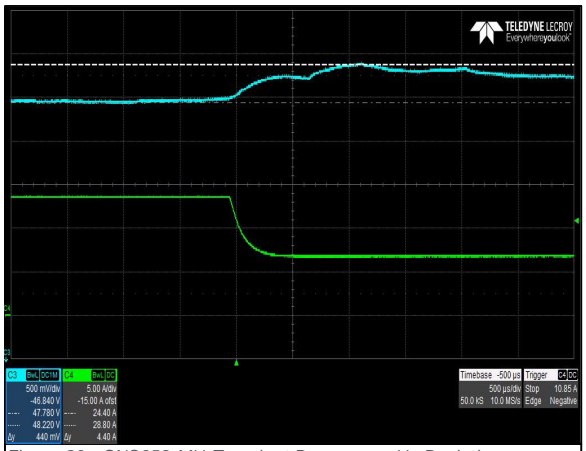



Figure 30: CNS658-MU Transient Response – Vo Deviation
$V_{IN}$ = 90Vac, $I_O$ = 100% to 50%, Output Cap = 330uF/A
Ch 3: $V_O$ Ch 4: $I_O$

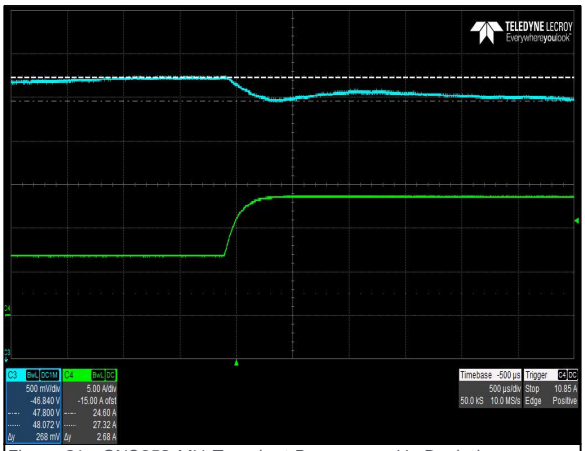



Figure 31: CNS658-MU Transient Response – Vo Deviation
$V_{IN}$ = 90Vac, $I_O$ = 100% to 50%, Output Cap = 330uF/A
Ch 3: $V_O$ Ch 4: $I_O$

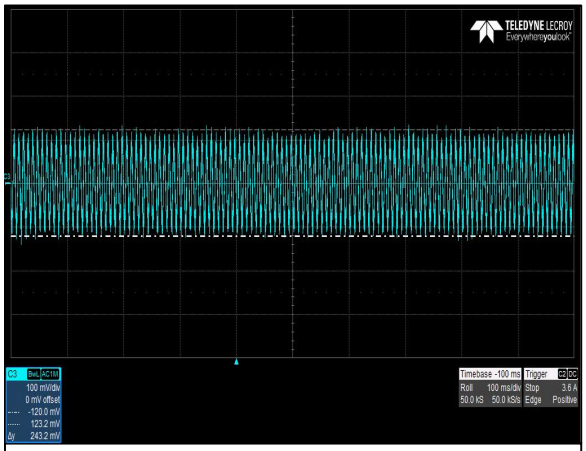



Figure 32: CNS658-MU Ripple and Noise Measurement
Vin = 115Vac, Load: $I_O$ = 8.3A
Ch 3: $V_O$

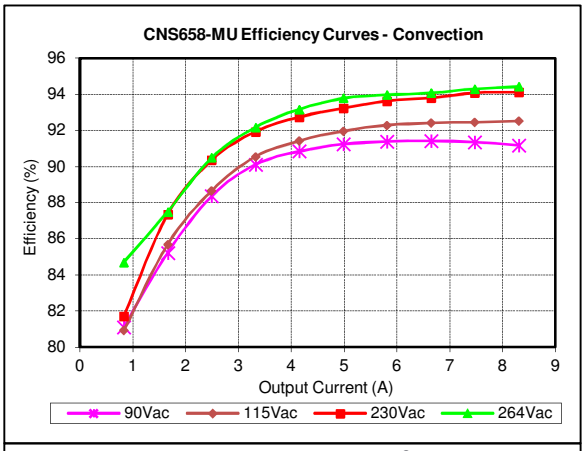



Figure 33: CNS658-MU Efficiency Curves @ 25°C
Convection Cooling
$V_{IN}$ = 90 to 264Vac, Load: $I_O$ = 0 to 8.3A

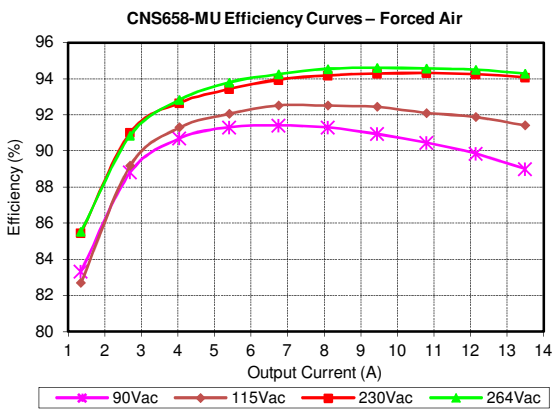



Figure 34: CNS658-MU Efficiency Curves @ 25°C
Forced Air
$V_{IN}$ = 90 to 264Vac, Load: $I_O$ = 0 to 13.5A

# ELECTRICAL SPECIFICATIONS

## Protection Function Specifications

### Input Fuse

CNS650-M series is equipped with internal non user serviceable 12A Fast Acting 500Vac/400Vdc fuses to IEC 60127-2 for fault protection in both L and N input.

### Over Voltage Protection (OVP)

The CNS650-M comes with Over Voltage Protection circuit. When the Main Output voltage reaches OVP range, the Main and 12V Fan Outputs will turn-off/latch-off. The 5V Standby will remain On. The AC input will need to be cycled or the Remote Inhibit toggled for the Main and 12V Fan Outputs to reset and turn back on.

If the 5V Standby goes into OVP, the entire power supply will turn-off/latch-off until the AC input is re-cycled or the Remote Inhibit toggled.

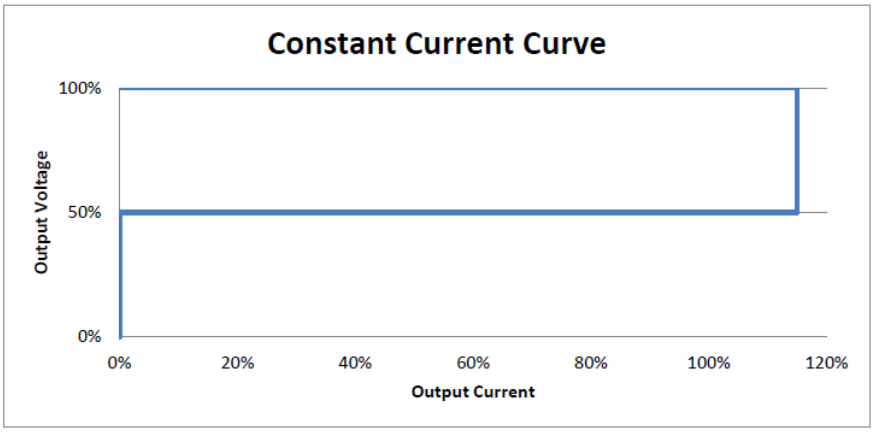
| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| $V_O$ Output Overvoltage | 110 | / | 150 | $\%V_O$ |

### Over Current Protection (OCP)

Main Output: In the event of an over current/over load, the Main Output will enter into constant current mode when the output voltage remains within 50%~100% of Vout nominal. If Vout drops below 50%, the Main and 12V Fan Outputs will shutdown and enter into hiccup mode. The 5V Standby will remain on. The power supply will auto-recover once the fault condition cease to exist. This OCP mode allows for power supply startup and operation with motor loads(inductive) and highly capacitive loads.

5V Standby: An over current/over load on the 5V Standby Output will shut down the entire power supply. The power supply will auto-recover once the fault condition cease to exist.

| Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|
| $V_O$ Output Overvoltage | 115 | / | 170 | $\%I_{O,max}$ |



# ELECTRICAL SPECIFICATIONS

## Protection Function Specifications

### Short Circuit Protection (SCP)

The CNS650-M power supplies will withstand a continuous short circuit with no permanent damage, applied to its main output during start-up or while running. A short circuit is defined as an impedance on Vo of 0.1 ohms or less.

When the main output is shorted, the output will go to “hiccup mode”. Recovery will be automatic when the short is removed.

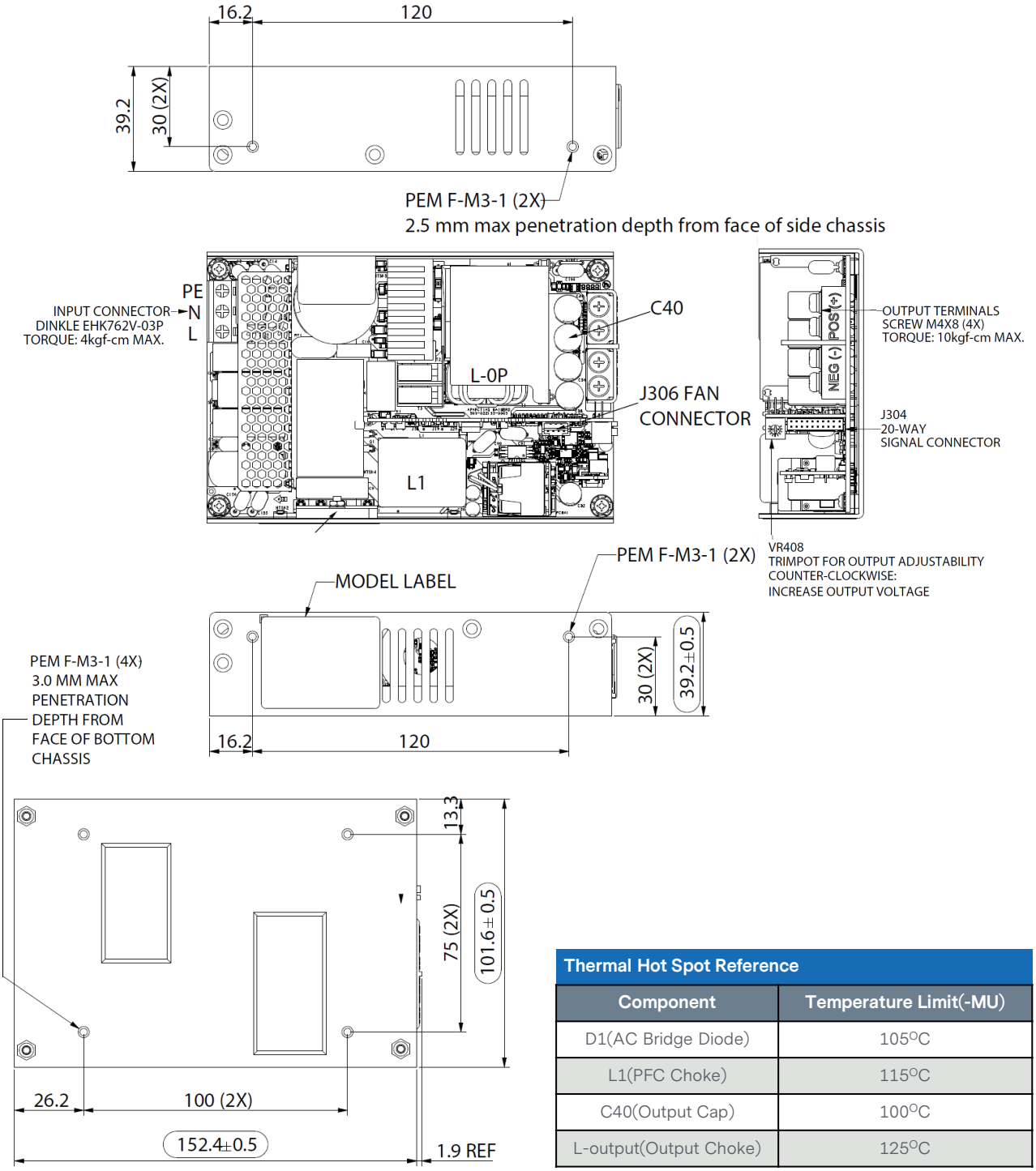
The 5V Standby will remain On while the 12V Fan Output is Off. A Short Circuit on the 5V Standby will shutdown the entire power supply. The power supply will auto recover once the fault condition cease to exist.

### Over Temperature Protection (OTP)

The power supply will be internally protected against over temperature conditions. There will be three over-temperature protection sensing - on the main output, the PFC circuit and on the standby output. When one of the sensing circuits has reached the OTP limit, all outputs, except standby, will shut down and will remain off until the over-temperature condition no longer exists. A suitable hysteresis point between the OTP threshold and the recovery point will be set to ensure there is no frequent on-off cycling of the outputs. The temperature recovery point will be set well-within the operating temperature range. Upon reaching the temperature recovery point, all outputs will auto-recover.

# MECHANICAL SPECIFICATIONS

## Mechanical Outlines ("-MU" Suffix for U-Base Construction / 12V, 24V and 48V. Unit: mm)



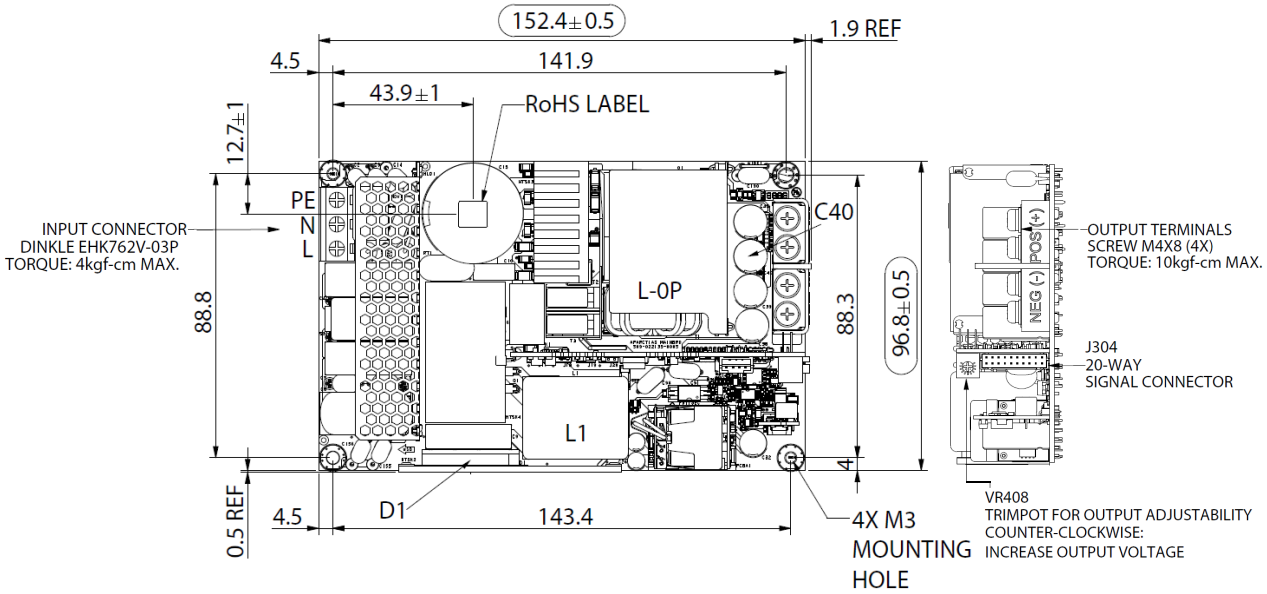

**Thermal Hot Spot Reference**

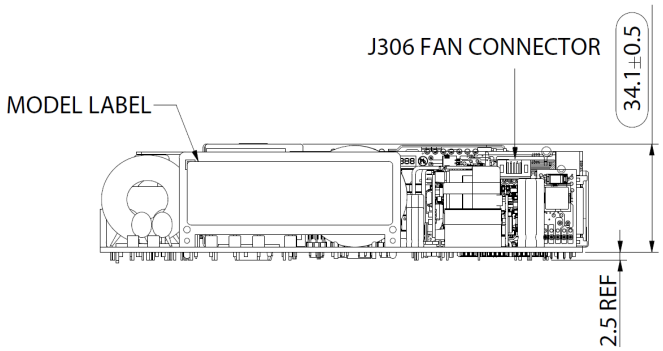
| Component | Temperature Limit(-MU) |
|---|---|
| D1(AC Bridge Diode) | 105°C |
| L1(PFC Choke) | 115°C |
| C40(Output Cap) | 100°C |
| L-output(Output Choke) | 125°C |

Do not exceed indicated temperature limits to ensure operation is within the component thermal derating limits. Measure the component temperatures using K type thermocouples.

# MECHANICAL SPECIFICATIONS

## Mechanical Outlines (“-MF” Suffix for Open-frame Construction / 12V only. Unit: mm)



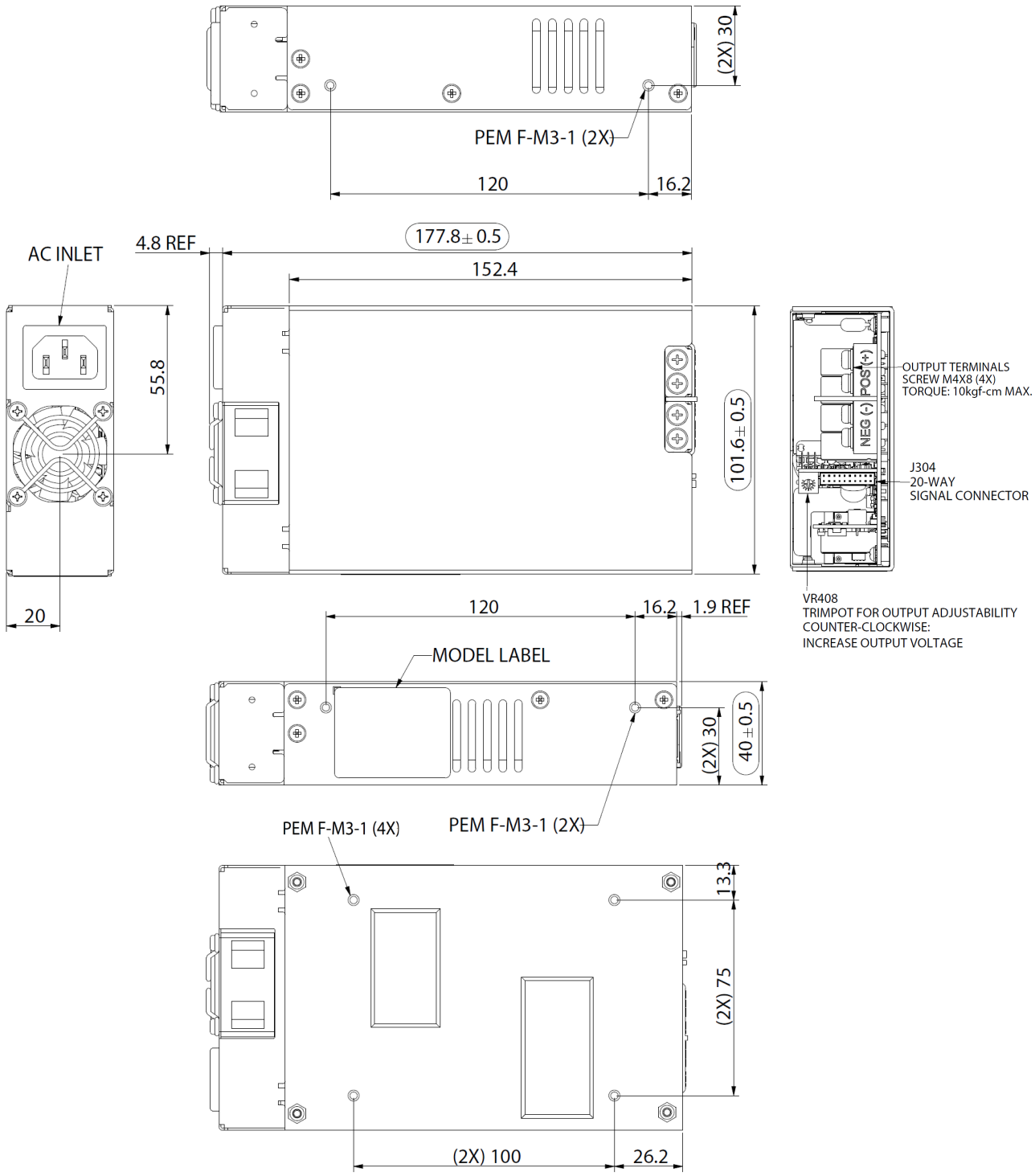

**Thermal Hot Spot Reference**

| Component | Temperature Limit(-MU) |
|---|---|
| D1(AC Bridge Diode) | 105°C |
| L1(PFC Choke) | 115°C |
| C40(Output Cap) | 100°C |
| L-output(Output Choke) | 125°C |

Do not exceed indicated temperature limits to ensure operation is within the component thermal derating limits. Measure the component temperatures using K type thermocouples.

# MECHANICAL SPECIFICATIONS

## Mechanical Outlines ("-ME" Suffix for End-fan Construction / 12V only. Unit: mm)



# MECHANICAL SPECIFICATIONS

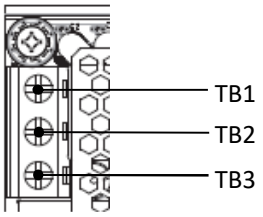
## Connector Definitions

AC Input Connector(“MU”, “MF” suffix)

TB 1 – PE

TB 2 – Neutral

TB 3 – Line




AC Input Connector(“ME” suffix)

IEC 60320 C14 (Male)

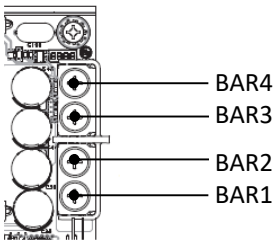
DC Output Connector

BAR1 – -Vout

BAR2 – -Vout

BAR3 – +Vout

BAR4 – +Vout




J306 – Fan Header

F1 – 12VFAN

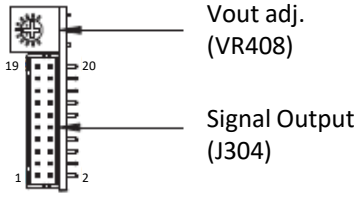
F2 – FAN_RTN

F3 – FAN_PWM1

F4 – FAN_TACH1

J304 - Signal Output Connector

| | |
|---|---|
| S1 – 5VSB | S11 – FAN_RTN |
| S2 – 5VSB | S12 – VIN_GOOD |
| S3 – 5VSB_GND | S13 – FAN_PWM1 |
| S4 – SCL | S14 – PWOK |
| S5 – A0 | S15 – FAN_TACH1 |
| S6 – SDA | S16 – FAN_OVERRIDE |
| S7 – I_SHARE | S17 – FAN_FAIL |
| S8 – SYS_GND | S18 – FAN_FAULT_EN |
| S9 – 12VFAN | S19 – REMOTE_SENSE+ |
| S10 – REMOTE INHIBIT | S20 – REMOTE_SENSE- |



# MECHANICAL SPECIFICATIONS

## Power / Signal Mating Connectors and Pin Types

Table 4. Mating Connectors for CNS650-M Series

| Reference | Power Supply Side | Mating Connector or Equivalent |
|---|---|---|
| AC Input Connector(-MU and -MF Suffix) | Dinkle EHK762V-03P<br>Max Torque: 4kgf-cm | Recommended Wire Size: AWG #22 to #14 |
| AC Input Connector(-ME Suffix) | IEC 60320 C14 (Male) | IEC Cord C13 (Female) |
| Output Connector | Output Terminal Screw: M4X8 (4X) Max Torque: 10kgf-cm | Molex 19099-0032 or 19141-0063 for AWG #16 to #14<br>Molex 19099-0048 or 19141-0083 for AWG #12 to #10 |
| Signal Connector(J304) | CviLux: CI0120P1HD0-LF<br>Landwin: 2052P20008T | CviLux: CI0120SD000 (housing)<br>CI01TD21PE0 (contact pins)<br>Landwin: 2050S2000 (housing)<br>2053T021V (contact pins)<br>JST: PHDR-20VS (housing)<br>SPHD-001T-P0.5 (contact pins) |
| Fan Connector(J306) | CviLux: CI0104P1HK0-LF<br>Landwin: 2003P0401V | CviLux: CI0104S0000 (housing)<br>CviLux: CI01T01MPP0 (contact pins)<br>Landwin: 2001S0400 (housing)<br>Landwin: 2005T011R (contact pins) |

# MECHANICAL SPECIFICATIONS

## Weight

The CNS650-MU series weigh 800g/1764lbs.

The CNS650-MF series weigh 650g/1433lbs.

The CNS650-ME series weigh 1000g/2205lbs.

# ENVIRONMENTAL SPECIFICATIONS

## EMC Immunity

CNS650-M series power supply is designed to meet the following EMC immunity specifications.

**Table 5. Environmental Specifications**

| Document | Description |
|---|---|
| FCC 47CFR 15 Subpart B / CISPR 22/ EN55032, Class B | Conducted and Radiated (tested with Cover) EMI Limits. |
| EN61000-3-2 | Harmonic Current Emisions, 230Vac with full load, ClassA. |
| EN61000-3-3 | Voltage Fluctuations and Flicker Measurements. |
| IEC/EN 61000-4-2 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques – Electrostatic discharge immunity test. +/-15KV air, +/-8KV contact discharge, performance Criteria A. |
| IEC/EN 61000-4-3 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Radiated, radio-frequency, 10V/m electromagnetic field immunity test, Criteria A. |
| IEC/EN 61000-4-4 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Electrical Fast Transient/Burst Immunity Test. ±2KV injected on Line, Neutral and PE for 1minute minimum. Performance Criteria A. |
| IEC/EN 61000-4-5 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Surge Immunity – Level 3: ±2KV common mode and ±1KV differential mode for AC ports, Performance criteria A; Tested to Level 4 with Performance Criteria C. |
| IEC/EN 61000-4-6 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Conducted Disturbance Susceptibility – 0.15-80MHz at 3V 1kHz sine wave, performance criteria A. |
| IEC/EN 61000-4-8 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques, Power Frequency Magnetic Field Immunity – 30A/m 50Hz Strength with 60sec performance criteria A. |
| IEC/EN 61000-4-11 | Electromagnetic Compatibility (EMC) - Testing and measurement techniques : Voltage Dips and Interruptions: 30% reduction for 500ms, Criteria A; 60% reduction for 100mS, Criteria B; >95% reduction for 10mS, Criteria A; >95% reduction for 5000mS, Criteria B. |
| EN55024 | Information Technology Equipment - Immunity Characteristics - Limits and methods of measurement. |
| EN 60601-1-2:2014 | Medical Electrical Equipment - General requirements for Safety. |

# ENVIRONMENTAL SPECIFICATIONS

## Safety Certifications

The CNS650-M series power supply is intended for inclusion in other equipment and the installer must ensure that it is in compliance with all the requirements of the end application. This product is only for inclusion by professional installers within other equipment and must not be operated as a stand alone product.

**Table 6. Safety Certifications for CNS650-M Series Power Supply System**

| Standard | File # | Description |
|---|---|---|
| UL/CSA | E186249-A6009-CB-1<br>E186249-A6009-UL-X10<br>E186249-A310-CB-2 | IEC 62368-1:2014 (Second Edition), EN 62368-1:2014+A11:2017<br>UL 62368-1, 2nd Ed, 2014-12-01, CAN/CSA C22.2 No. 62368-1-14, 2nd Ed<br>IEC 60950-1:2005 (Second Edition) +Am1:2009+Am2:2013, EN 60950-1:2006 + A1:2010 + A11:2009 + A12:2011 +A2:2013 |
| TUV | B16051389002676 | EN 60601-1:2006/A1:2013 |
| CE | 19349 | 2014/35/EU (LVD); 2011/65/EU (RoHS); EN 60601-1-2:2014 |
| CB | DK-50917-A2-UL<br>DK-77275-M1-UL<br>SG-MD-00582M2 | IEC 62368-1(ed.2), IEC 62368-1(ed.2);am1, IEC 62368-1(ed.2);am2<br>IEC 62368-1:2014<br>IEC 60601-1(ed.3);am1 |
| CCC | C-00401-Z1604QD-01982 | China Requirements<br>GB4943.1-2011; GB9254-2008; GB17625.1-2012 |
| DEMKO | D-06185 | EN 62368-1:2014 |

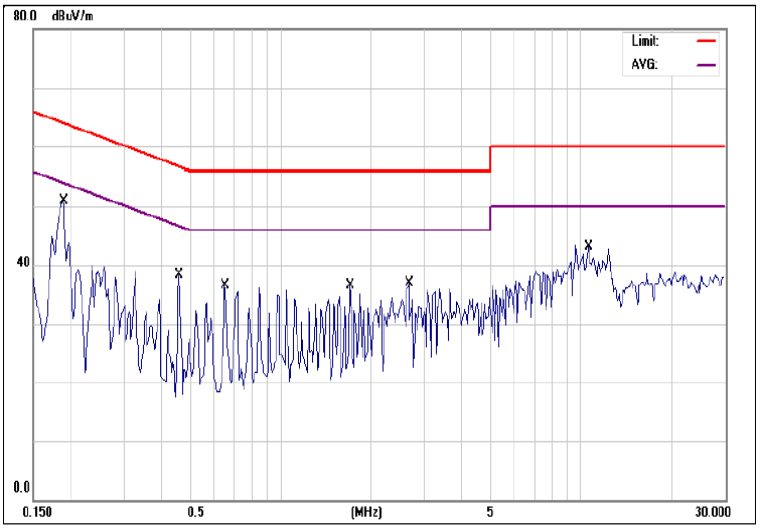
# ENVIRONMENTAL SPECIFICATIONS

## EMI Emissions

The CNS650-M series have been designed to comply with the Class B limits per requirements of EN55032 (FCC Part 15) and CISPR 22 (EN55032) for emissions. The unit is tested with Class I input (PE connected) at 650W full load using resistive load with airflow.

### Conducted Emissions

The CNS650-M power supplies have internal EMI filters to ensure the power supply's conducted EMI levels comply with EN55022 (FCC Part 15) and EN55022 (CISPR 22) Class B limits. Conducted noise can appear as both differential mode and common mode noise currents. Differential mode noise is measured between the two input lines, with the major components occurring at the supply fundamental switching frequency and its harmonics. Common mode noise, a contributor to both radiated emissions and input conducted emissions, is measured between the input lines and system ground and can be broadband in nature.




Sample of EN55022 Conducted Emission. Measured at 120Vac input; 650 W Load; Class I Input (PE connected)

Note: Red Line refers to Advanced Energy Quasi Peak margin, which is 6dB below the CISPR international limit. Purple Line refers to Advanced Energy margin, which is 6dB below the CISPR international limit.

Conducted EMI emissions specifications of the CNS650-M series:

| Parameter | Model | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| FCC Part 15, Class B | All | Margin | - | - | 6 | dB |
| CISPR 22 (EN55022) Class B | All | Margin | - | - | 6 | dB |

### Radiated Emissions

Unlike conducted EMI, radiated EMI performance in a system environment may differ drastically from that in a stand-alone power supply. The shielding effect provided by the system enclosure may bring the EMI level from Class A to Class B. It is thus recommended that radiated EMI be evaluated in a system environment. The applicable standard is EN55022 Class A (FCC Part 15). Testing ac-dc convertors as a stand-alone component to the exact requirements of EN55022 can be difficult, because the standard calls for 1m leads to be attached to the input and outputs and aligned such as to maximize the disturbance. In such a set-up, it is possible to form a perfect dipole antenna that very few ac-dc convertors could pass. However, the standard also states that 'an attempt should be made to maximize the disturbance consistent with the typical application by varying the configuration of the test sample'.

# ENVIRONMENTAL SPECIFICATIONS

## Operating Temperature

The CNS650-M series power supplies can start at -40°C and operate within stated specifications at an ambient temperature from -20°C to 80°C with derating.

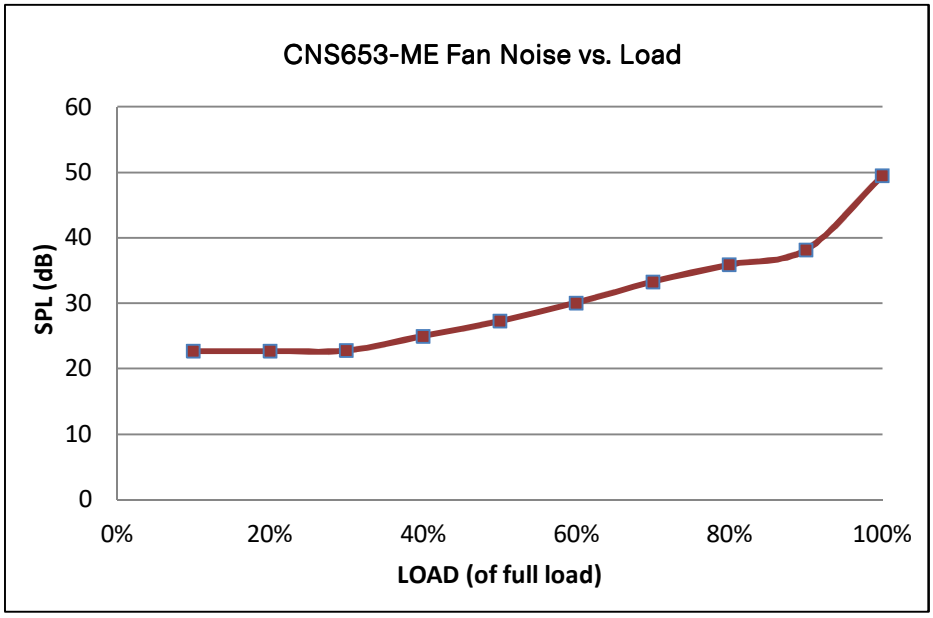
### Forced Air Cooling

The CNS653-ME power supply includes internal cooling fan as part of the power supply assembly to provide forced air-cooling to maintain and control temperature of devices and ambient temperature in the power supply to appropriate levels. The standard direction of airflow is from the AC connector end to the DC connector end of the power supply.

The cooling fan is a variable speed fan. In standby mode power supply fan will operate at minimum speed to maintain component reliability at all load, line and ambient conditions. When 12V output is enabled, power supply fan will operate at minimum achievable fan speed. Power supply fan speed control algorithms will vary the speed so that the critical component temperatures do not exceed safe operating levels. Fan will be powered from voltage source inside the power supply.

## Fan Noise vs. Output Load Curves

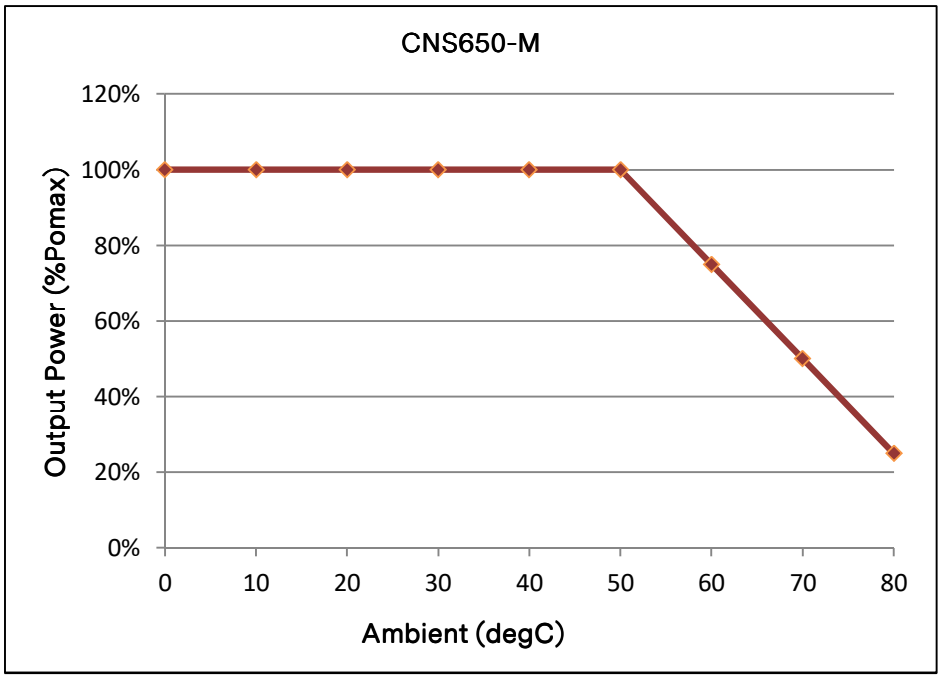
CNS653-ME(End Fan) typical audible noise level vs. Output Load at 90Vac, 30°C Ambient.



# ENVIRONMENTAL SPECIFICATIONS

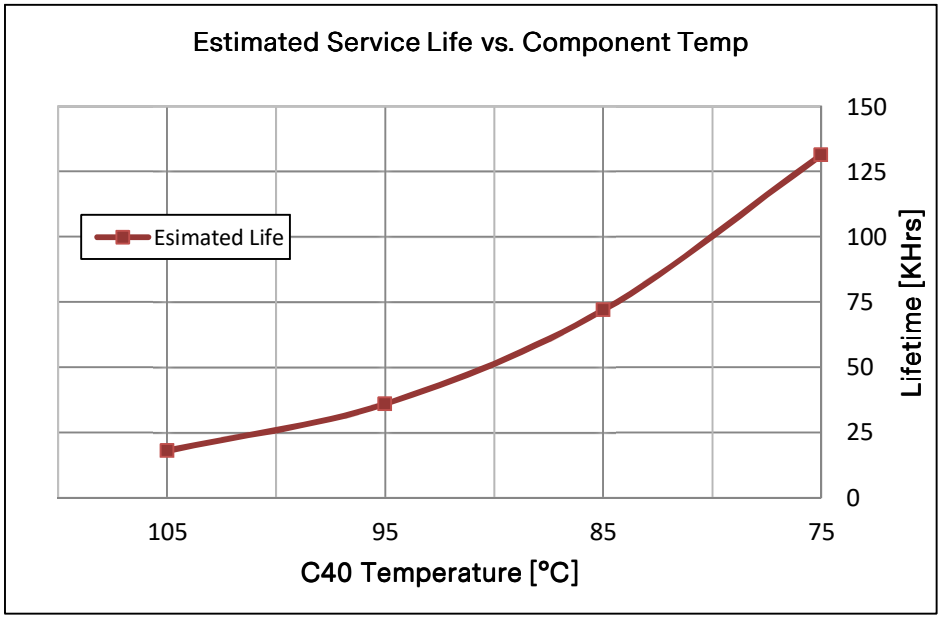
## Power Derating Curves

CNS650-M series total output power will be derated according to the curve shown below. All models can provide derated output power from 50°C up to 80°C ambient temperature max.




## Estimated Service Life

CNS650-M estimated useful life is based on C40 case temperature.



# ENVIRONMENTAL SPECIFICATIONS

## Storage and Shipping Temperature / Humidity

The CNS650-M series power supplies can be stored or shipped at temperatures from –40 $^{O}$C to +85 $^{O}$C and relative humidity from 5% to 95% non-condensing.

### Humidity

Operating: Power supply will be designed to operate with no degradation of performance while operating in range of 20% RH to 95%RH non-condensing.

Non-Operating: Power supply will be designed to operate with no degradation of performance while operating in range of 10%RH-95%RH non-condensing.

### Vibration

The CNS650-M series power supplies will pass the following vibration specifications:

| | | | |
|---|---|---|---|
| Acceleration | 1 | | gRMS |
| Frequency Range | 9-200 | | Hz |
| Duration | 30 | | mins |
| Direction | Rotating each axis on vertical vibration | | |
| PSD Profile | **FREQ**<br>5 Hz<br>20Hz<br>200 Hz | **SLOPE dB/oct** | **PSD $g^2$/Hz**<br>0.001 $g^2$/Hz<br>0.010 $g^2$/Hz<br>0.010 $g^2$/Hz |

### Shock

The CNS650-M power supply will pass the following vibration specifications:

| | | |
|---|---|---|
| Acceleration | 10 | G |
| Duration | 18 | msec |
| Pulse | Half-Sine | |
| No. of Shock | 3 shock on each of 6 faces | |

# POWER AND CONTROL SIGNAL DESCRIPTIONS

## AC Input Connector

This connector supplies the AC Mains to the CNS650-M power supplies.

TB 1 - Earth Ground
TB 2 - Neutral
TB 3 - Line

## Output Connector

This connector supplies the Output Voltage Mains.

+Vout – Output Positive

-Vout – Output Negative

## Fan Output Connector for -MU, -MF suffix

12VFAN, FAN_RTN– (pins F1, F2)

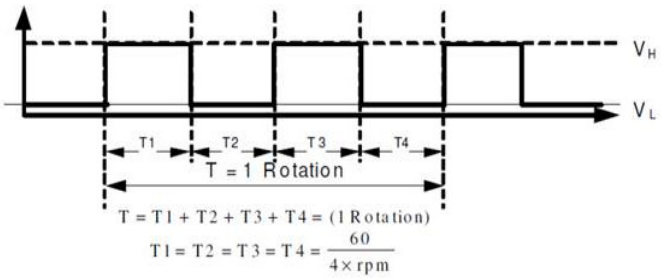
12VFAN is red wire, FAN_RTN is black wire. Both are for the fan input.

FAN_PWM1– (pins F3)

Fan PWM signal is yellow wire, it controls fan speed depending on output duty cycle. The external fan to be connected would need a PWM input pin for speed control.

FAN_TACH1– (pins F4)

Fan tachometer signal is blue wire, it is connected to tacho pin of the external fan, which used for fan speed RPM reporting and fault detection. For correct reporting and fault detection, the pulse period per revolution of the external fan to be used should be:



# POWER AND CONTROL SIGNAL DESCRIPTIONS

## Output Connector - Control Signals

The CNS650-M series contain a 20 pins control signal header providing an analogue control interface, standby power and I2C interface signal connections.

### 12VFAN, FAN_RTN, FAN_PWM1, FAN_TACH1, FAN_FAULT_EN – (pins S9, S11, S13, S15, S18)

These signals are for fan application.12VFAN, and FAN_RTN are for the fan input. FAN_PWM1 controls the fan speed. Below tables show the voltage levels:

| FAN_TACH1 | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| High Level Input Voltage | Vin | - | 3.3 | - | V |
| Low Level Input Voltage | Vin | - | 0 | - | V |

| FAN_FAIL | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| High Level Input Voltage | Vin | - | 3.3 | - | V |
| Low Level Input Voltage | Vin | - | 0 | - | V |

| FAN_PWM1 | Symbol | Min | Typ | Max | Units | Notes and Conditions |
|---|---|---|---|---|---|---|
| High Level Input Voltage | Vin | - | 3.3 | - | V | Control the FAN speed |
| Low Level Input Voltage | Vin | - | 0 | - | V | |

### FAN_OVERRIDE – (pins S16)

Analog input signal used to override the fan PWM duty. The input range is 1-3.3V, 1V is equivalent to 0% duty and 3.3V is equivalent to 100% duty override setting. It can only override the duty if it is greater than the PSU internal fan control algorithm target duty.

| FAN_OVERRIDE | Symbol | Min | Typ | Max | Units |
|---|---|---|---|---|---|
| High Level Input Voltage | Vin | - | 3.3 | - | V |
| Low Level Input Voltage | Vin | - | 1 | - | V |

### FAN_FAULT_EN – (pins S18)

This is an output signal that asserts high if a fan fault is detected. Fan fault will be triggered if the PRM detected from FAN_TACH1 is less that 1000RMM in 10 seconds.

| FAN_FAULT_EN | Symbol | Min | Typ | Max | Units | Notes and Conditions |
|---|---|---|---|---|---|---|
| High Level Input Voltage | Vin | 2.3 | - | - | V | Disabled |
| Low Level Input Voltage | Vin | - | - | 1.35 | V | Enabled |

# POWER AND CONTROL SIGNAL DESCRIPTIONS

## REMOTE_SENSE+, REMOTE_SENSE- – (pins S19, S20)

The main output of the CNS650-M series is equipped with a Remote Sensing capability that will compensate for a power path drop around 0.5V. This feature is implemented by connecting the Main Output Remote Sense Positive (pin S19) and the Main Output Remote Sense Return (pin S20) to the positive and negative rails of the main output, respectively, at a location that is near to the load. Care should be taken in the routing of the sense lines as any noise sources or additional filtering components introduced into the voltage rail may affect the stability of the power supply. The CNS650-M will operate appropriately without the sense lines connected; however it is recommended that the sense lines be connected directly to the main output terminals if remote sensing is not required. This remote sense circuit will not raise the power supply's output voltage to the OVP trip level. Main Output Remote Sense has no effect on the Standby Output (Vsb).

12V Main output and Standby output return lines are connected together inside PSU and connected to PSU chassis directly. It is recommended to connect 12V return to system chassis on end system application for better common mode noise.

## 5VSB, 5VSB_RTN – (pins S1-S2, S3)

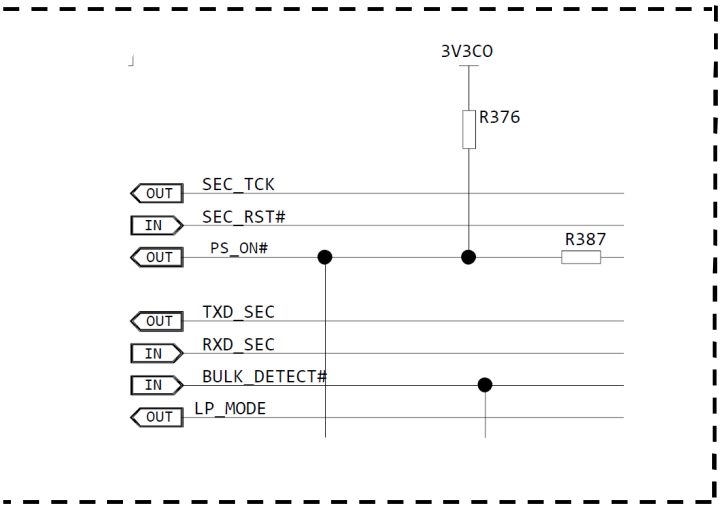
The CNS650-M series provide a regulated 5V and 1A auxiliary output voltage at free air cooling, 2A at forced air. The Standby Output (Vsb) voltage is available whenever a valid AC input voltage is applied to the unit. The Standby Output is independently short circuit protected and is referenced to the Standby Output Return pins (S3).

## REMOTE INHIBIT – (pin S10)

This pin inhibits the power supply main output. This pin is pulled up 3.3V with a R376 = 10KOhm resistor. This pin is an active low input and the input voltage shows below:

| Remote INHIBIT | Symbol | Min | Typ | Max | Units | Notes and Conditions |
|---|---|---|---|---|---|---|
| High Level Input Voltage | Vin | 2.3 | - | - | V | Remote IHIBIT guarantee high sate |
| Low Level Input Voltage | Vin | - | - | 1.35 | V | Remote IHIBIT guarantee low sate |

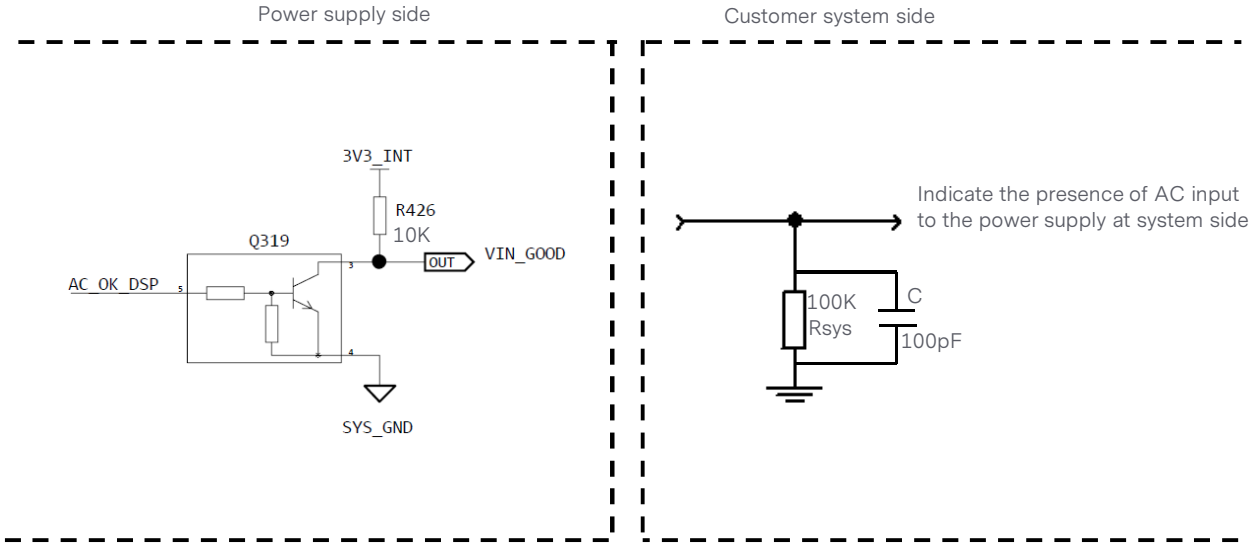
Power supply side



# POWER AND CONTROL SIGNAL DESCRIPTIONS

## VIN_GOOD – (pin S12)

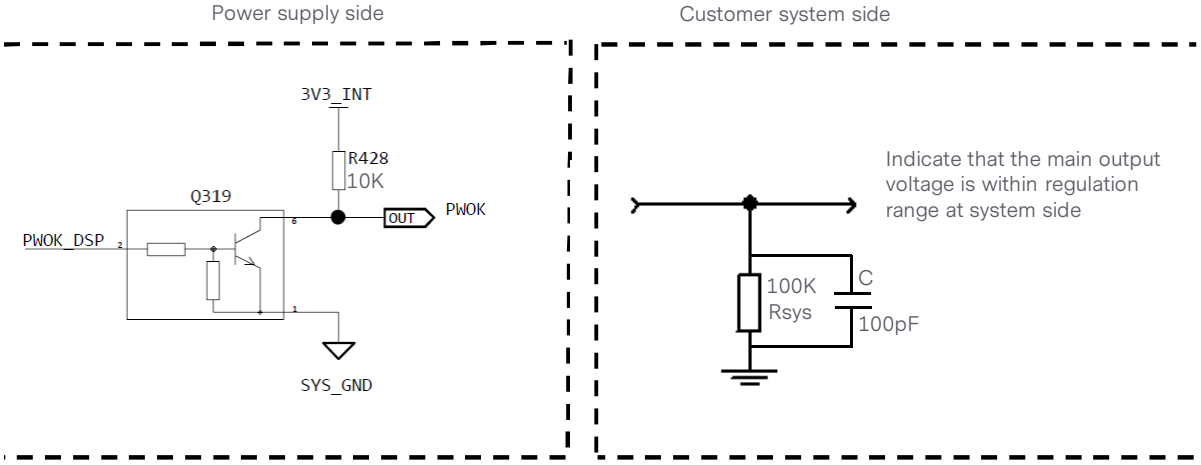
Signal used to indicate the presence of AC input to the power supply. A logic level HIGH will indicate that the AC input to the power supply is within the operating range while a logic level LOW will indicate that AC has been lost. This is an open collector/drain output. This pin is pulled high by a R426 = 10Kohm resistor connected to 3.3V inside the power supply. It is recommended that this pin be connected to a 100pF decoupling capacitor and pulled down by a 100kohm resistor.




## PWOK – (pin S14)

Signal used to indicate that main output voltage is within regulation range. The Output Power OK signal will be driven HIGH when the output voltage is valid and will be driven LOW when the output falls below the under-voltage threshold. This signal also gives an advance warning when there is an impending power loss due to loss of AC input or system shutdown request.

This is an open collector/drain output. This pin is pulled high by a R428 = 10Kohm resistor connected to 3.3V inside the power supply. It is recommended that this pin be connected to a 100pF decoupling capacitor and pulled down by a 100kohm resistor.



# POWER AND CONTROL SIGNAL DESCRIPTIONS

### I_SHARE – (pin S7)

The CNS650-M series support active current sharing through a single wire connection between the power supplies. This input/output signal pin just allows two power supplies to share the main output load current to increase the overall power capability or to operate the units in a N+N configuration for redundancy purpose.

The voltage of this signal will be a linear slope from no load to full load. If the current share is 0%, the current share voltage is 0V. If the current share is 50%, the current share voltage is 4V. If the current share is 100%, the current share voltage is 8V.

### SCL, SDA and SYS_GND – (pins S4, S6 and S8)

Please refer to "Field Replaceable Unit" section.

### A0 – (pin S5)

Please refer to “Field Replaceable Unit" section.

# COMMUNICATION BUS DESCRIPTIONS

## I²C Bus Signals

The CNS650-M power supply contains enhanced monitoring and control functions implemented via the I²C bus. The CNS650-M I²C functionality (PMBus™ and FRU data) can be accessed via the output connector control signals. The communication bus is powered either by the internal 3.3V supply or from an external power source connected to the standby output (i.e. accessing an unpowered power supply as long as the standby output of another power supply connected in parallel is on).

If units are connected in parallel or in redundant mode, the standby outputs must be connected together in the system. Otherwise, the I²C bus will not work properly when a unit is inserted into the system without the AC source connected.

Note: PMBus™ functionality can be accessed only when the PSU is powered-up. Guaranteed communication I²C speed is 100KHz.

### SDA, SCL (I²C Data and Clock Signals) – (pin 6, 4)

I²C serial data and clock bus - these pins are internally pulled up to internal 3.3V supply with a 100K resistor. These pins are recommended to be pulled-up in the system by a 2.2K ohm resistor to the Standby Output.

### A0 (I²C Address BIT 0, BIT1 Signals) – (pin 5)

These two input pins are the address lines A0 and A1 to indicate the slot position the power supply occupies in the power bay and define the power supply addresses for FRU data and PMBus™ data communication. This allows the system to assign different addresses for each power supply. During I²C communication between system and power supplies, the system will be the master and power supplies will be slave.

They are internally pulled up to internal 3.3V supply with a 10K resistor.

### I²C Bus Communication Interval

The interval between two consecutive I²C communications to the power supply should be at least 50ms to ensure proper monitoring functionality.

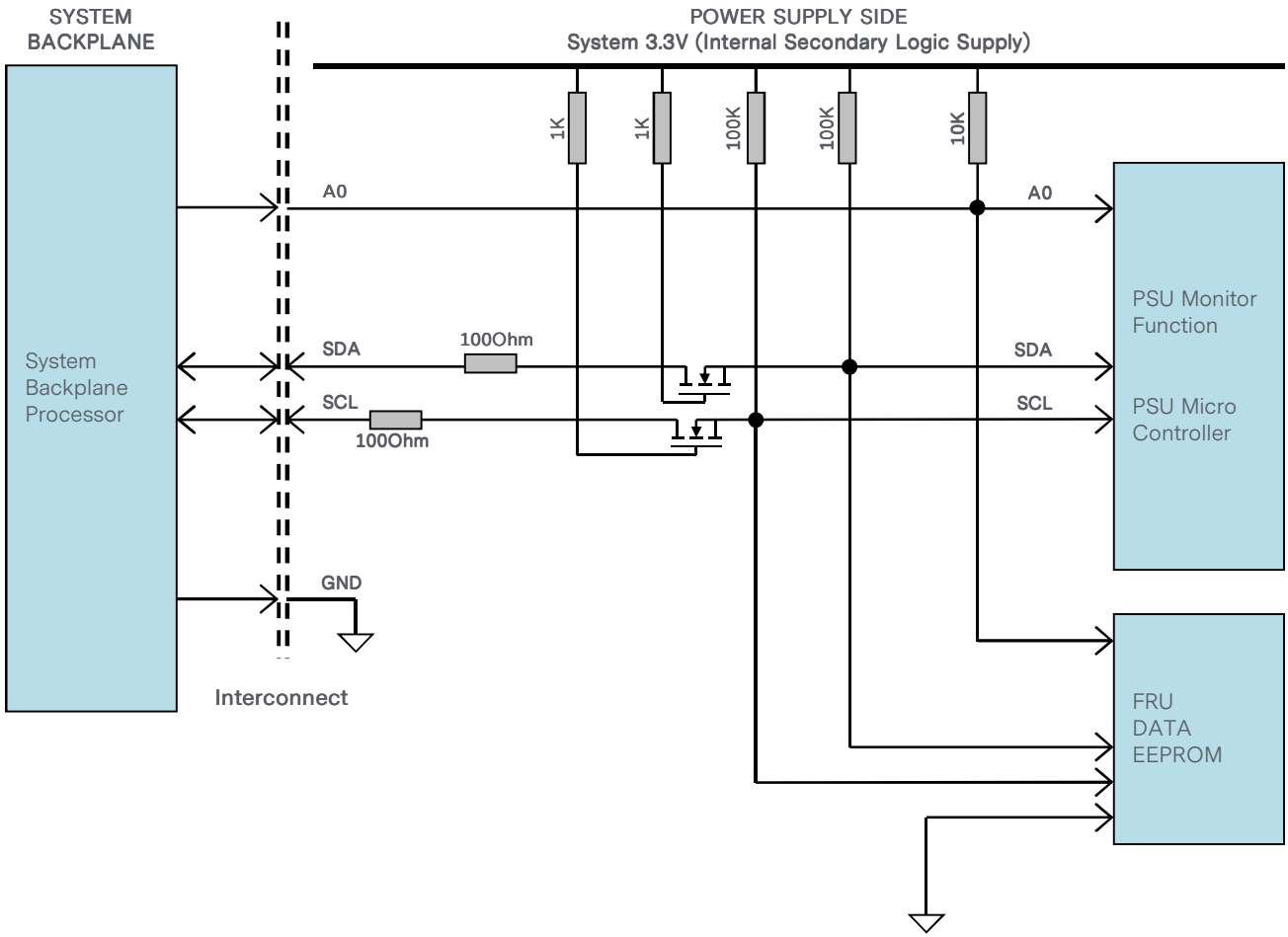
### I²C Bus Signal Integrity

The noise on the I²C bus (SDA, SCL lines) due to the power supply will be less than 500mV peak-to-peak. This noise measurement should be made with an oscilloscope bandwidth limited to 100MHz. Measurements should be make at the power supply output connector with 3.2K ohm resistors pulled up to standby output and 20pF ceramic capacitors to standby output return.

The noise on the address lines A0 and A1 will be less than 100mV peak-to-peak. This noise measurement should be made at the power supply output connector.

# COMMUNICATION BUS DESCRIPTIONS

## I²C Bus Internal Implementation, Pull-ups and Bus Capacitances




## I²C Bus - Recommended external pull-ups

Electrical and interface specifications of I²C signals (referenced to standby output return pin, unless otherwise indicated):

| Parameter | Condition | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| SDA, SCL Internal Pull-up Resistor | | $R_{int}$ | - | 100 | - | Kohm |
| SDA, SCL Internal Bus Capacitance | | $C_{int}$ | - | 0 | - | pF |
| Recommended External Pull-up Resistor | 1 to 2 PSU | $R_{ext}$ | - | 2.2 | - | Kohm |

# COMMUNICATION BUS DESCRIPTIONS

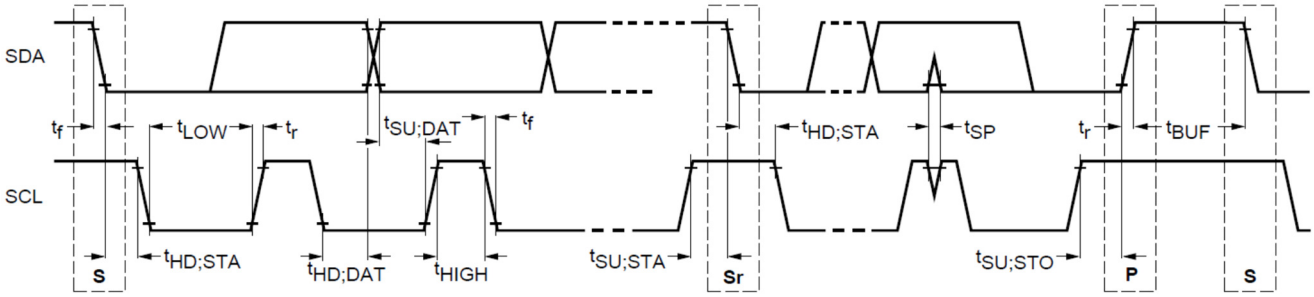
## Logic Levels

CNS650-M series power supply I²C Communication Bus will respond to logic levels as per below:

Logic High: 3.3V Nominal (Specs is 2.1V to 5.5V)**
Logic Low: 500mV nominal (Specs is 800mV max)**

**Note: Artesyn 73-769-001 I²C adapter is used.

### Timings




| Parameter | Symbol | Standard-Mode Specs | | Actual Measured | | Unit |
|---|---|---|---|---|---|---|
| | | Min | Max | | | |
| SCL Clock Frequency | $f_{SCL}$ | 0 | 100 | 98.0 | | KHz |
| Hold time (repeated) START condition | $t_{HD;STA}$ | 4.0 | - | 4.7 | | mS |
| LOW period of SCL clock | $t_{LOW}$ | 4.7 | - | 15.2 | | mS |
| HIGH period of SCL clock | $t_{HIGH}$ | 4.0 | - | 4.0 | | mS |
| Setup time for repeated START condition | $t_{SU;STA}$ | 4.7 | - | 4.95 | | mS |
| Data hold time | $t_{HD;DAT}$ | 0 | 3.45 | 0.26 | | mS |
| Data setup time | $t_{SU;DAT}$ | 250 | - | 3920 | | nS |
| Rise time | $t_r$ | - | 1000 | SCL = 800 | SDA = 940 | nS |
| Fall time | $t_f$ | - | 300 | SCL = 120 | SDA = 120 | nS |
| Setup time for STOP condition | $t_{SU;STO}$ | 4.0 | - | 6.36 | | mS |
| Bus free time between a STOP and START condition | $t_{BUF}$ | 4.7 | - | 100*** | | mS |

*** Note Artesyn 73-769-001 I²C adapter (USB-to-I²C) and Universal PMBus™ GUI software was used.

# COMMUNICATION BUS DESCRIPTIONS

## Device Addressing

The CNS650-M series will respond to supported commands on the $I^2C$ bus that are addressed to pin A0 pins of output connector.

Address pins are held HIGH by default via pulled up to internal 3.3V supply with a 10K resistor. To set the address as “0”, the corresponding address line should be pulled down to logic ground level. Below tables show the address of the power supply with A0 pin set to either “0” or “1”.

| PSU Slot | Slot ID Bits | PMBus™ Address | EEPROM (FRU) Read Address |
|---|---|---|---|
| | A0 | | |
| 1 | 0 | 0xB0 | 0xB0 |
| 2 | 1 | 0xB2* | 0xB2 |

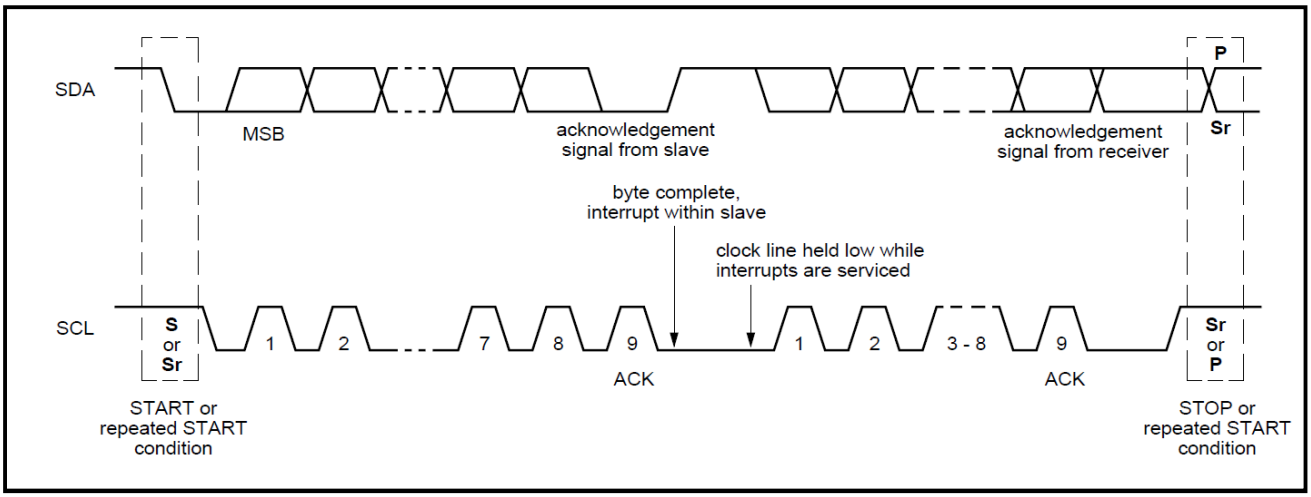
Note: * Default PMBus™ address when A0 is left open.

# COMMUNICATION BUS DESCRIPTIONS

## I²C Clock Synchronization

The CNS650-M power supply might apply clock stretching. An addressed slave power supply may hold the clock line (SCL) low after receiving (or sending) a byte, indicating that it is not yet ready to process more data. The system master that is communicating with the power supply will attempt to raise the clock to transfer the next bit, but must verify that the clock line was actually raised. If the power supply is clock stretching, the clock line will still be low (because the connections are open-drain).

The maximum time out condition for clock stretching for CNS650-M is 100 milliseconds.



# COMMUNICATION BUS DESCRIPTIONS

## FRU (EEPROM) Data

The FRU (Field Replaceable Unit) data format is compliant with the Intel IPMI v1.0 specification.

The CNS650-M series uses 1 page of EEPROM for FRU purpose. A page of EEPROM contains up to 256 byte-sized data locations.

Where: OFFSET -The OFFSET denotes the address in decimal format of a particular data byte withi CNS650-M series EEPROM.

VALUE -The VALUE details data written to a particular memory location of the EEPROM.

DEFINITION -The contents DEFINITION refers to the definition of a particular data byte.

CNS655-MU FRU (EEPROM) Data:

| OFFSET | | DEFINITION | SPEC VALUE | |
|---|---|---|---|---|
| (DEC) | (HEX) | (REMARKS) | (DEC) | (HEX) |
| | | COMMON HEADER, 8 BYTES | | |
| 0 | 00 | **FORMAT VERSION NUMBER** (Common header)<br>7:4 - Reserved, write as 0000b<br>3:0 - Format version number = 1h for this specification | 1 | 01 |
| 1 | 01 | **INTERNAL USE AREA OFFSET** (Not required, do not reserve) | 28 | 1B |
| 2 | 02 | **CHASSIS INFO AREA OFFSET** (Not required, do not reserve) | 1 | 01 |
| 3 | 03 | **BOARD INFO AREA OFFSET** (Not required, do not reserve) | 0 | 00 |
| 4 | 04 | **PRODUCT INFO AREA OFFSET** | 5 | 05 |
| 5 | 05 | **MULTI RECORD AREA OFFSET** | 13 | 0D |
| 6 | 06 | **PAD** (Not required, do not reserve) | 0 | 00 |
| 7 | 07 | **ZERO CHECK SUM** (256 - (Sum of bytes 0 to 6)) | NA | NA |
| | | CHASSIS INFO AREA( 32 BYTES)<br>This area will be filled by the Mfg. Diag. or by the OS if used | | |
| 8 | 08 | **FORMAT VERSION NUMBER**<br>7:4 - Reserved, write as 0000b<br>3:0 - Format version number = 1h for this specification | 1 | 01 |
| 9 | 09 | **CHASSIS INFO AREA LENGTH** in multiple of 8 bytes | 4 | 04 |
| 10 | 0A | **CHASSIS TYPE** (Default value is 0) | 0 | 00 |
| 11 | 0B | **CHASSIS PART NUMBER** Type/Length CAh (if used)<br>Type = “ASCII+LATIN1” = (11)b Length = 10 Bytes = (001010)b | 202 | CA |
| 12<br>13<br>14<br>15<br>16<br>17<br>18<br>19<br>20<br>21 | 0C<br>0D<br>0E<br>0F<br>10<br>11<br>12<br>13<br>14<br>15 | **CHASSIS PART NUMBER BYTES** (Default value is 0) | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | 00<br>00<br>00<br>00<br>00<br>00<br>00<br>00<br>00<br>00 |
| 22 | 16 | **CHASSIS SERIAL NUMBER Type/Length** CFH (if used)<br>Type = “ASCII+LATIN1” = (11)b Length = 15 Bytes = (001111)b | 207 | CF |
| 23<br>24<br>25<br>26<br>27<br>28<br>29<br>30<br>31 | 17<br>18<br>19<br>1A<br>1B<br>1C<br>1D<br>1E<br>1F | **CHASSIS SERIAL NUMBER BYTES** (Default value is 0) | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | 00<br>00<br>00<br>00<br>00<br>00<br>00<br>00<br>00 |

# COMMUNICATION BUS DESCRIPTIONS

CNS650-M FRU (EEPROM) Data:

| OFFSET | | DEFINITION | SPEC VALUE | |
|---|---|---|---|---|
| (DEC) | (HEX) | (REMARKS) | (DEC) | (HEX) |
| 32 | 1F | | 0 | 00 |
| 33 | 20 | | 0 | 00 |
| 34 | 22 | | 0 | 00 |
| 35 | 23 | | 0 | 00 |
| 36 | 24 | | 0 | 00 |
| 37 | 25 | | 0 | 00 |
| 38 | 26 | **End Tag** (0C1h if used) | 193 | C1 |
| 39 | 27 | **CHKSUM** (Zero CHKSUM if used) | 161 | A1 |
| | | **PRODUCT INFORMATION AREA, 56 BYTES** | | |
| 40 | 28 | **FORMAT VERSION NUMBER** (Product Info Area)<br>7:4 - Reserved, write as 0000b<br>3:0 - Format Version Number = 1h for this specification | 1 | 01 |
| 41 | 29 | **PRODUCT INFO AREA LENGTH** (In multiples of 8 bytes) | 8 | 08 |
| 42 | 2A | **Language** (English) | 25 | 19 |
| 43 | 2B | **MANUFACTURER NAME TYPE / LENGTH** (0C5H)<br>Type “ASCII+LATIN1” 5 Bytes. | 199 | C7 |
| | | **MANUFACTURER'S NAME** 5 byte sequence | | |
| 44 | 2C | “A” | 65 | 41 |
| 45 | 2D | “R” | 82 | 52 |
| 46 | 2E | “T” | 84 | 54 |
| 47 | 2F | “E” | 69 | 45 |
| 48 | 30 | “S” | 83 | 53 |
| 49 | 31 | “Y” | 89 | 59 |
| 50 | 32 | “N” | 78 | 4E |
| 51 | 33 | **PRODUCT NAME** Type/Length (CFH)<br>Type = “ASCII+LATIN1” = (11)b Length = 15 Bytes = (001100)b | 207 | CF |
| | | **Product Name** (15 Byte sequence) | | |
| 52 | 34 | “C” | 67 | 43 |
| 53 | 35 | “N” | 78 | 4E |
| 54 | 36 | “S” | 83 | 53 |
| 55 | 37 | “6” | 54 | 36 |
| 56 | 38 | “5” | 53 | 35 |
| 57 | 39 | “5” | 53 | 35 |
| 58 | 3A | “-” | 45 | 2D |
| 59 | 3B | “M” | 77 | 4D |
| 60 | 3C | “U” | 85 | 55 |
| 61 | 3D | | 32 | 20 |
| 62 | 3E | | 32 | 20 |
| 63 | 3F | | 32 | 20 |
| 64 | 40 | | 32 | 20 |
| 65 | 41 | | 32 | 20 |
| 66 | 42 | | 32 | 20 |
| 67 | 43 | **PRODUCT NAME** Type/Length (CFH)<br>Type = “ASCII+LATIN1” = (11)b Length = 15 Bytes = (001100)b | 207 | CF |
| | | **Product PART/MODEL NUMBER BYTES** | | |
| 68 | 44 | “C” | 67 | 43 |
| 69 | 45 | “N” | 78 | 4E |
| 70 | 46 | “S” | 83 | 53 |
| 71 | 47 | “6” | 54 | 36 |
| 72 | 48 | “5” | 53 | 35 |
| 73 | 49 | “5” | 53 | 35 |
| 74 | 4A | “-” | 45 | 2D |
| 75 | 4B | “M” | 77 | 4D |
| 76 | 4C | “U” | 85 | 55 |
| 77 | 4D | | 32 | 20 |
| 78 | 4E | | 32 | 20 |

# COMMUNICATION BUS DESCRIPTIONS

CNS650-M FRU (EEPROM) Data:

| OFFSET | | DEFINITION | SPEC VALUE | |
|---|---|---|---|---|
| (DEC) | (HEX) | (REMARKS) | (DEC) | (HEX) |
| 79<br>80<br>81<br>82 | 4F<br>50<br>51<br>52 | | 32<br>32<br>32<br>32 | 20<br>20<br>20<br>20 |
| 83 | 53 | **PRODUCT VERSION NUMBER** Type/Length (C2h)<br>Type = “ASCII+LATIN1” = (11)b Length = 2 bytes = (000010)b | 194 | C2 |
| 84<br>85 | 54<br>55 | **PRODUCT VERSION NUMBER BYTES**<br>“A”<br>“A” | 65<br>65 | 41<br>41 |
| 86 | 56 | **PRODUCT SERIAL NUMBER** Type/Length<br>Type = “ASCII+LATIN1” = (11)b Length = 13 bytes = (001101)b | 205 | CD |
| 87<br>88<br>89<br>90 | 57<br>58<br>59<br>5A | **PRODUCT SERIAL NUMBER BYTES**<br>Model ID = L842<br>“L”<br>“8”<br>“4”<br>“2” | 76<br>56<br>52<br>50 | 4C<br>38<br>34<br>32 |
| 91<br>92 | 5B<br>5C | **MANUFACTURING YEAR AND WEEK CODE**<br>Values for these registers shall be dynamically assigned in factory | XX<br>XX | XX<br>XX |
| 93<br>94<br>95<br>96 | 5D<br>5E<br>5F<br>60 | **Unique Serial Number**<br>Values for these registers shall be dynamically assigned in factory | XX<br>XX<br>XX<br>XX | XX<br>XX<br>XX<br>XX |
| 97<br>98 | 61<br>62 | **MODEL REVISION**<br>“A”<br>“A” | 65<br>65 | 41<br>41 |
| 99 | 63 | **MANUFACTURING LOCATION**<br>“P” In Decimal = 080 In Hex = 50H | 80 | 50 |
| 100 | 64 | **End Tag** | 193 | C1 |
| 101<br>102 | 65<br>66 | PAD (reserved), Default value is 0. | 0<br>0 | 00<br>00 |
| 103 | 67 | **ZERO CHECK SUM (256 – (Sum of bytes 40 to 102))**<br>Zero Check Sum :Should follow check sum calculation as per IPMI v1.1 specs | 193 | C1 |
| **Multi Record Area, 88 Bytes** | | | | |
| 104<br>105<br>106<br>107<br>108 | 68<br>69<br>6A<br>6B<br>6C | **Power Supply Record Header**<br>Record type = 00 for Power supply<br>End of List /Record Format Version Number<br>Record Length of Power Supply Record<br>Record CHECKSUM of Power Supply Record (Zero CHECKSUM) (256-(sum of bytes 109 to 132))<br>Header CHECKSUM of Power Supply Record Header (Zero HECKSUM) ((256-(sum of bytes 104 to 107)) | 0<br>2<br>24<br>XXX<br>XXX | 00<br>02<br>18<br>XX<br>XX |
| **Power Supply Record** | | | | |
| 109<br>110 | 6D<br>6E | **Overall Capacity of the Power Supply**, 650W = 028AH<br>2 Bytes Sequence<br>In Decimal = 138, 002<br>In Hex = 8AH, 02H | 138<br>2 | 8A<br>02 |
| 111<br>112 | 6F<br>70 | Peak VA, 828W = 033CH<br>2 Bytes Sequence<br>In Decimal = 060, 003<br>In Hex = 3CH, 03H | 60<br>3 | 3C<br>03 |

# COMMUNICATION BUS DESCRIPTIONS

CNS650-M FRU (EEPROM) Data:

| OFFSET | | DEFINITION | SPEC VALUE | |
|---|---|---|---|---|
| (DEC) | (HEX) | (REMARKS) | (DEC) | (HEX) |
| 113 | 71 | **Inrush Current**, 50A = 32H<br>In Decimal = 050<br>In Hex = 32H | 50 | 32 |
| 114 | 72 | **Inrush Interval**, 10mS<br>In Decimal = 010<br>In Hex = 0AH | 10 | 0A |
| 115<br>116 | 73<br>74 | **Low End Input Voltage Range 1(10mV),** (90V / 10mV) 9000 = 2328H<br>2 Bytes Sequence<br>In Decimal = 040, 035<br>In Hex = 28H, 23H | 40<br>35 | 28<br>23 |
| 117<br>118 | 75<br>76 | **High End Input Voltage Range 1(10mV),** (264V/10mV) 26400= 6720H<br>2 Bytes Sequence<br>In Decimal = 032, 103<br>In Hex = 20H, 67H | 32<br>103 | 20<br>67 |
| 119<br>120 | 77<br>78 | **Low End Input Voltage Range 2(10mV)**<br>Not Applicable<br>(Autoswitch) | 0<br>0 | 00<br>00 |
| 121<br>122 | 79<br>7A | **High End Input Voltage Range 2(10mV)**<br>Not Applicable<br>(Autoswitch) | 0<br>0 | 00<br>00 |
| 123 | 7B | **Low End Input Frequency Range**, 47Hz = 2FH | 47 | 2F |
| 124 | 7C | **Low End Input Frequency Range**, 63Hz = 3FH | 63 | 3F |
| 125 | 7D | **AC Dropout Tolerance in ms,** 10mS= 0AH | 10 | 0A |
| 126 | 7E | **Binary Flags**, 1 indicates function supported and a 0 not supported.<br>Bits 7-6: RESERVED, WRITE AS 000B<br>Bit 5: PMBus Capable or not BIT = 1<br>Bit 4: Tachometer Pulses Per Rotation / Predictive Fail Polarity BIT = 0<br>Bit 3: Hot Swap / Redundancy Support BIT = 0<br>Bit 2: Auto switch Support BIT = 1<br>Bit 1: Power Factor Correction Support BIT = 1<br>Bit 0: Predictive Fail Support BIT = 0 | 38 | 26 |
| 127<br>128 | 7F<br>80 | **Peak Wattage Capacity**<br>780W = 30CH<br>Bits 11- 0: Peak Capacity in Watts 1800 = 708H<br>2 Bytes sequence:<br>In Decimal: 012, 003<br>In Hex: 0CH, 03H | 12<br>3 | 0C<br>03 |
| 129<br>130<br>131 | 81<br>82<br>83 | **Combined Wattage,** Not Applicable<br>Byte 1: 000 = 00H<br>Bits 7-4: 0000B<br>Bits 3-0: 0000B<br>Byte 2 and Byte 3: 00H, 00H<br>3 Bytes Sequence<br>In Decimal = 000, 000, 000<br>In Hex = 00H, 00H, 00H | 0<br>0<br>0 | 00<br>00<br>00 |
| 132 | 84 | **Predictive Fail Tachometer Lower Threshold,** Not Applicable.<br>Predictive Failure is not Supported. | 0 | 00 |
| **12V DC OUTPUT RECORD HEADER** | | | | |
| 133<br>134<br>135<br>136<br>137 | 85<br>86<br>87<br>88<br>89 | Record type = 01 for DC Output Record<br>End of List /Record Format Version Number for 12V DC Output Record<br>Record Length of 12V DC Output Record<br>Record CHECKSUM of 12V DC Output Record (Zero CHECKSUM)<br>(256-(sum of bytes 138 to 150))<br>Header CHECKSUM of 12V DC Output Record Header (Zero CHECKSUM) (256-(sum of bytes 133 to 136) | 1<br>2<br>13<br>XXX<br>XXX | 01<br>02<br>0D<br>XX<br>XX |

# COMMUNICATION BUS DESCRIPTIONS

CNS650-M FRU (EEPROM) Data:

| OFFSET | | DEFINITION | SPEC VALUE | |
|---|---|---|---|---|
| (DEC) | (HEX) | (REMARKS) | (DEC) | (HEX) |
| | | **12V OUTPUT RECORD** | | |
| 138 | 8A | **Output Information,** 001 = 01H<br>Bit 7: Standby Information = 0B<br>Bits 6-4: Reserved, Write as 000B<br>Bits 3-0: Output Number 1 = 001B | 1 | 01 |
| 139<br>140 | 8B<br>8C | **Nominal Voltage (10mV), (12V / 10mV)** 1200 = 04B0H<br>2 Bytes Sequence<br>In Decimal: 176, 004<br>In Hex: B0H, 04H | 176<br>4 | B0<br>04 |
| 141<br>142 | 8D<br>8E | **Maximum Negative Voltage Deviation (10mV),** 1380 = 0564H<br>2 Bytes Sequence<br>In Decimal: 176, 004<br>In Hex: B0H, 04H | 176<br>4 | B0<br>04 |
| 143<br>144 | 8F<br>90 | **Maximum Positive Voltage Deviation (10mV),** 1380 =0564H<br>2 Bytes Sequence<br>In Decimal: 236, 004<br>In Hex: ECH, 04H | 236<br>4 | EC<br>04 |
| 145<br>146 | 91<br>92 | **Ripple and Noise pk-pk (mV),** 120 = 0078H<br>2 Bytes Sequence<br>In Decimal: 120, 000<br>In Hex: 078H, 00H | 120<br>0 | 78<br>00 |
| 147<br>148 | 93<br>94 | **Minimum Current Draw (10mA),** 0000 = 0000H<br>2 Bytes Sequence<br>In Decimal: 000, 000<br>In Hex: 00H, 00H | 0<br>0 | 00<br>00 |
| 149<br>150 | 95<br>96 | **Maximum Current Draw (10mA),** 10000 = 2710H<br>2 Bytes Sequence<br>In Decimal: 040, 021<br>In Hex: 28H, 15H | 40<br>21 | 28<br>15 |
| | | **5VSB OUTPUT RECORD HEADER** | | |
| 151<br>152<br>153<br>154<br><br>155 | 97<br>98<br>99<br>9A<br><br>9B | Record type = 01 for DC Output Record<br>End of List /Record Format Version Number for 5VSB Output Record<br>Record Length of 5VSB Output Record<br>Record CHECKSUM of 5VSB Output Record (Zero CHECKSUM)<br>(256-(sum of bytes 156 to 168)<br>Header CHECKSUM of 5VSB Output Record Header (Zero CHECKSUM)<br>(256-(sum of bytes 151 to 154) | 1<br>2<br>13<br>XXX<br><br>XXX | 01<br>02<br>0D<br>XX<br><br>XX |
| | | **5VSB OUTPUT RECORD** | | |
| 156 | 9C | **Output Information,** 002 = 02H<br>Bit 7: Standby Information = 1B<br>Bits 6-4: Reserved, Write as 000B<br>Bits 3-0: Output Number 2 = 010B | 130 | 82 |
| 157<br>158 | 9D<br>9E | **Nominal Voltage (10mV),** (5.0V / 10mV) 5000 = 01F4h<br>2 Bytes Sequence<br>In Decimal: 244, 001<br>In Hex: F4H, 01h | 74<br>1 | 4A<br>01 |
| 159<br>160 | 9F<br>A0 | **Maximum Negative Voltage Deviation (10mV),** (4.75V/10mV) 475= 01DBh<br>2 Bytes Sequence<br>In Decimal: 219, 001<br>In Hex: DBH, 01h | 219<br>1 | DB<br>01 |

# COMMUNICATION BUS DESCRIPTIONS

CNS650-M FRU (EEPROM) Data:

| OFFSET | | DEFINITION | SPEC VALUE | |
|---|---|---|---|---|
| (DEC) | (HEX) | (REMARKS) | (DEC) | (HEX) |
| | | **Maximum Positive Voltage Deviation (10mV),** (5.25V/ 10mV) 525 =020Dh<br>2 Bytes Sequence | | |
| 161 | A1 | In Decimal: 013, 002 | 13 | 0D |
| 162 | A2 | In Hex: 5AH, 02H | 2 | 02 |
| | | **Ripple and Noise pk-pk (mV),** 50 = 0032H<br>2 Bytes Sequence | | |
| 163 | A3 | In Decimal: 050, 000 | 50 | 32 |
| 164 | A4 | In Hex: 32H, 01H | 0 | 00 |
| | | **Minimum Current Draw (10mA),** (0.0A / 10mA) 0 = 0000H<br>2 Bytes Sequence | | |
| 165 | A5 | In Decimal: 000, 000 | 0 | 00 |
| 166 | A6 | In Hex: 00H, 00H | 0 | 00 |
| | | **Maximum Current Draw (10mA),** (2.0A / 10mA) 200 = 00C8H<br>2 Bytes Sequence | | |
| 167 | A7 | In Decimal: 200, 000 | 200 | C8 |
| 168 | A8 | In Hex: C8H, 00H | 0 | 00 |
| OEM RECORD HEADER | | | | |
| 169 | A9 | Record type = C0H for OEM Record | 192 | C0 |
| 170 | AA | End of List /Record Format Version Number for 5Vsb output Record | 130 | 82 |
| 171 | AB | Record Length of OEM Record | 42 | 2A |
| 172 | AC | Record CHECKSUM of OEM Record (Zero CHECKSUM) (256-(sum of | 0 | 00 |
| 173 | AD | bytes 174 to 215) | 148 | 94 |
| | | Header CHECKSUM of OEM Record Header (Zero CHECKSUM) (256-(sum of bytes 169 to 172) | | |
| OEM RECORD | | | | |
| 177 | B1 | RESERVED | 0 | 00 |
| 178 | B2 | RESERVED | 0 | 00 |
| 179 | B3 | RESERVED | 0 | 00 |
| 180 | B4 | RESERVED | 0 | 00 |
| 181 | B5 | RESERVED | 0 | 00 |
| 182 | B6 | RESERVED | 0 | 00 |
| 183 | B7 | RESERVED | 0 | 00 |
| 184 | B8 | RESERVED | 0 | 00 |
| 185 | B9 | RESERVED | 0 | 00 |
| 186 | BA | RESERVED | 0 | 00 |
| 187 | BB | PAD (reserved), Default value is 0. | 0 | 00 |
| 188 | BC | | 0 | 00 |
| 189 | BD | | 0 | 00 |
| 190 | BE | | 0 | 00 |
| 191 | BF | | 0 | 00 |
| 192 | C0 | | 0 | 00 |
| 193 | C1 | | 0 | 00 |
| 194 | C2 | | 0 | 00 |
| 195 | C3 | | 0 | 00 |
| 196 | C4 | | 0 | 00 |
| 197 | C5 | | 0 | 00 |
| 198 | C6 | | 0 | 00 |
| 199 | C7 | | 0 | 00 |
| 200 | C8 | | 0 | 00 |
| 201 | C9 | | 0 | 00 |
| 202 | CA | | 0 | 00 |
| 203 | CB | | 0 | 00 |
| 204 | CC | | 0 | 00 |
| 205 | CD | | 0 | 00 |
| 206 | CE | | 0 | 00 |
| 207 | CF | | 0 | 00 |

# COMMUNICATION BUS DESCRIPTIONS

CNS650-M FRU (EEPROM) Data:

| OFFSET | | DEFINITION | SPEC VALUE | |
|---|---|---|---|---|
| (DEC) | (HEX) | (REMARKS) | (DEC) | (HEX) |
| 208 | D0 | | 0 | 00 |
| 209 | D1 | | 0 | 00 |
| 210 | D2 | | 0 | 00 |
| 211 | D3 | | 0 | 00 |
| 212 | D4 | | 0 | 00 |
| 213 | D5 | | 0 | 00 |
| 214 | D6 | | 0 | 00 |
| 215 | D7 | | 0 | 00 |
| INTERNAL USE AREA, 40 BYTES | | | | |
| 216 | D8 | **FORMAT VERSION NUMBER**<br>7:4 - Reserved , write as 0000b<br>3:0 - Format Version Number = 1h for this specification | 0 | 00 |
| 217 | D9 | **INTERNAL USE AREA LENGTH** in multiple of 8 bytes | 0 | 00 |
| 218 | DA | | 0 | 00 |
| 219 | DB | | 0 | 00 |
| 220 | DC | | 0 | 00 |
| 221 | DD | | 0 | 00 |
| 222 | DE | | 0 | 00 |
| 223 | DF | | 0 | 00 |
| 224 | E0 | | 0 | 00 |
| 225 | E1 | | 0 | 00 |
| 226 | E2 | | 0 | 00 |
| 227 | E3 | | 0 | 00 |
| 228 | E4 | | 0 | 00 |
| 229 | E5 | | 0 | 00 |
| 230 | E6 | | 0 | 00 |
| 231 | E7 | | 0 | 00 |
| 232 | E8 | | 0 | 00 |
| 233 | E9 | | 0 | 00 |
| 234 | EA | | 0 | 00 |
| 235 | EB | | 0 | 00 |
| 236 | EC | | 0 | 00 |
| 237 | ED | | 0 | 00 |
| 238 | EE | | 0 | 00 |
| 239 | EF | | 0 | 00 |
| 240 | F0 | | 0 | 00 |
| 241 | F1 | | 0 | 00 |
| 242 | F2 | | 0 | 00 |
| 243 | F3 | | 0 | 00 |
| 244 | F4 | | 0 | 00 |
| 245 | F5 | | 0 | 00 |
| 246 | F6 | | 0 | 00 |
| 247 | F7 | | 0 | 00 |
| 248 | F8 | | 0 | 00 |
| 249 | F9 | | 0 | 00 |
| 250 | FA | | 0 | 00 |
| 251 | FB | | 0 | 00 |
| 252 | FC | | 0 | 00 |
| 253 | FD | | 0 | 00 |
| 254 | FE | | 0 | 00 |
| 255 | FF | Zero CHECKSUM (256-(sum of bytes 216 to 254) | 250 | FA |

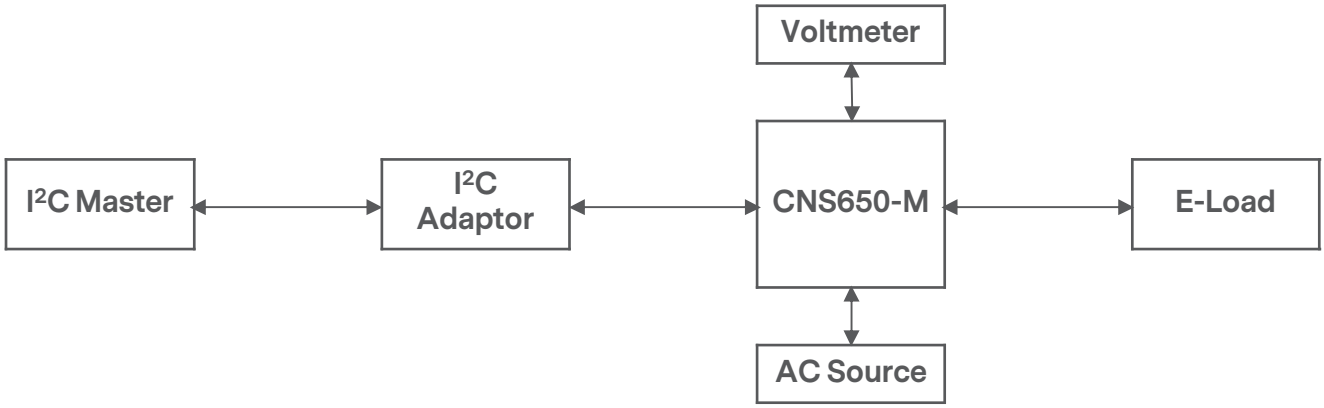
# PMBus™ SPECIFICATIONS

The CNS650-M series are compliant with the industry standard PMBus™ protocol for monitoring and control of the power supply via the I²C interface port.

## CNS650-M Series PMBus™ General Instructions

### Equipment Setup

The following is typical I²C communication setup:




### PMBus™ Writing Instructions

When writing to any PMBus™ R/W registers, ALWAYS do the following:

Disable Write Protect (command 10h) by writing any of the following accordingly:

Levels: 00h - Enable writing to all writeable commands

20h - Disables write except 10h, 01h, 00h, 02h and 21h commands

40h - Disables write except 10h, 01h, and 00h commends

80h - Disable write except 0x00h

To save changes on the USER PMBus™ Table:

Use send byte command: 15h STORE_USER_ALL

To save changes on the DEFAULT PMBus™ Table:

Use send byte command: 11h STORE_DEFAULT_ALL

Wait for 5 seconds, turn-off the PSU, wait for another 5 seconds before turning it on.

# PMBus™ SPECIFICATIONS

The CNS653-M Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 00h | PAGE | 00h | R | 1 | Hex | |
| 01h | OPERATION | 80h | R/W | 1 | Bitmapped | Used to turn the unit ON/OFF in conjunction with the input INH_EN pin. |
| | b7:6 | 10 | | | | 01 – Soft Turn OFF (With Sequencing)<br>10 - PSU ON |
| | b5:4 | 00 | | | | |
| | b3:2 | 00 | | | | |
| | b1:0 | 00 | | | | Reserved |
| 02h | ON_OFF_CONFIG | 1Eh | R | 1 | Bitmapped | Configures the combination of INH_EN pin and serial communication commands needed to turn the unit ON/OFF. |
| | b7:5 | 000 | | | | Reserved |
| | b4 – Enable INH_EN pin and Serial communication control. | 1 | | | | 0 – Unit powers up any time power is present regardless of the state of INH_EN pin.<br>1 – Unit powers up as dictated by INH_EN pin and OPERATION command (b3:0) . |
| | b3 – Serial communication Control | 1 | | | | 0 – Unit Ignores ON/OFF portion of the OPERATION command.<br>1 – Enables Serial communication ON/OFF portion of OPERATION command.<br>Requires INH_EN pin to be asserted for the unit to start and energize the output. |
| | b2 – Sets how the unit responds to INH_EN pin | 1 | | | | 0 – Unit ignores INH_EN pin. (ON/OFF controlled by OPERATION command).<br>1 – Unit requires INH_EN pin to be asserted to start the unit. |
| | b1 – INH_EN pin polarity | 1 | | | | 0 – Active Low (Pull Low to start the unit).<br>1 – Active high (Pull high to start the unit). |
| | b0 – INH_ENL pin action | 0 | | | | 0 – Use programmed turn ON/OFF delay.<br>1 – Turn OFF the output and stop transferring energy to the output as fast as possible. |
| 03h | CLEAR_FAULTS | 00 | S | | N/A | |
| 10h | WRITE_PROTECT | 80h | R/W | 1 | Bitmapped | Used to Control Writing to the PMBus Device<br>80h – Disables write except 10h<br>40h – Disables write except 10h, 01h, 00h<br>20h – Disables write except 10h, 01h, 00h, 02h and 21h<br>00 – Enables write to all writeable commands. |

# PMBus™ SPECIFICATIONS

The CNS653-M Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 15h | STORE_USER_ALL | - | S | 0 | | Copies the Operating memory table to the matching USER non-volatile memory. |
| 1Bh | SMBALERT_MASK | | | 2 | Bitmapped | |
| 20h | VOUT_MODE | 17h | R | 1 | Bitmapped | Specifies the mode and parameters of Output Voltage related Data Formats |
| 21h | VOUT_COMMAND | 12.0 | R/W | 2 | Linear | Sets the Output Voltage Reference<br>“12V” CNS653-M(U, E, F)<br>“24V” CNS655-MU<br>“48V” CNS658-MU<br>Vout command sends discreet value to change<br>or trim output voltage. The value acts as Digital reference of the Power supply after additional operations are performed (to make the representation compatible).<br>“12-13.8V” CNS653-M(U, E, F)<br>“24-27.6V” CNS655-MU<br>“48-55.2V” CNS658-MU<br>Affects OVP_WARNING and FAULT LIMIT, as well as POWER_OK_ON/OFF level. |
| 24h | VOUT_MAX | 13.8 | R | 2 | Linear | Sets the max adjustable output voltage limit. “13.8V” CNS653-M(U, E, F)<br>“27.6V” CNS655-MU<br>“55.2V” CNS658-MU |
| 35h | VIN_ON | 90 | R | 2 | Linear | 90 Vac |
| 36h | VIN_OFF | 80 | R | 2 | Linear | 80 Vac |
| 3Ah | FAN_ CONFIG_1_2 | 90h | R | 1 | Bitmapped | Used to configure up to 2 fans associated with one PMBus device |
| | b7 | 1 | | | | 1 – Fan is installed in position 1<br>0 – No Fan installed in position 1 |
| | b6 | 0 | | | | 1 – Fan is commanded in RPM<br>0 – Fan is commanded in DC |
| | b5:4 | 01 | | | | 00 – 1 pulse per revolution<br>01 – 2 pulses per revolution<br>10 – 3 pulses per revolution<br>11 – 4 pulses per revolution |
| | b3 | 0 | | | | 1 – Fan is installed in position 2<br>0 – No Fan installed in position 2 |
| | b2 | 0 | | | | 1 – Fan is commanded in RPM<br>0 – Fan is commanded in DC |
| | b1:0 | 00 | | | | 00 – 1 pulse per revolution<br>01 – 2 pulses per revolution<br>10 – 3 pulses per revolution<br>11 – 4 pulses per revolution |

# PMBus™ SPECIFICATIONS

The CNS653-M Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 3Bh | FAN_COMMAND_1 | 0 | R/W | 2 | Linear | Adjusts the operation of the Fans. The device may override the command, if it requires higher value, to maintain proper device temperature.<br>RPM Control – Commands Speeds from 0-11000 RPM.<br>Duty cycle Control – Commands Speeds from 0 to 100% |
| 40h | VOUT_OV_FAULT_LIMIT | 16.2 | R | 2 | Linear | Sets Output Over voltage threshold. (130% to 150% of Vout) |
| 42h | VOUT_OV_WARN_LIMIT | 15 | R | 2 | Linear | Sets Over-voltage Warning threshold. (120% to 130% of Vout) |
| 43h | VOUT_UV_WARN_LIMIT | 10.2 | R | 2 | Linear | Sets Under-voltage Warning threshold. (80% to 90% of Vout) |
| 44h | VOUT_UV_FAULT_LIMIT | 9 | R | 2 | Linear | Sets Under-voltage Fault threshold. (60% to 80% of Vout) |
| 46h | IOUT_OC_FAULT_LIMIT | 65 | R/W | 2 | Linear | Sets the Over current threshold in Amps. (50% to 130% of Max Load) |
| 47h | IOUT_OC_FAULT_RESPONSE | 40h | R | 1 | Bitmapped | OCP ride through. If OCP persists. |
| 4Ah | IOUT_OC_WARN_LIMIT | 58.5 | R | 2 | Linear | Sets the Over Current Warning threshold in Amps. (105% to 120% of Max Load) |
| 4Fh | OT_FAULT_LIMIT | 120 | R | 2 | Linear | Secondary ambient temperature Fault threshold, in degree C. (120 degC) |
| 51h | OT_WARN_LIMIT | 115 | R | 2 | Linear | Secondary ambient temperature warning threshold, in degree C. Operating limit. refer to section 3.1. (115 degC) |
| 59h | VIN_UV_FAULT_LIMIT | 80 | R | 2 | Linear | (80Vac) |
| 6Ah | POUT_OP_WARN_LIMIT | 715 | R | 2 | Linear | 715W |
| 78h | STATUS_BYTE | 00h | R | 1 | Bitmapped | Returns the summary of critical faults |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under--voltage fault has occurred |
| | b2 - TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE OF THE ABOVE | | | | | A Fault Warning not listed in bits[7:1] has occurred. |

# PMBus™ SPECIFICATIONS

The CNS653-M Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 79h | STATUS_WORD | 0000h | R | 2 | | Summary of units Fault and warning status. |
| | b15 – VOUT | | | | | An output voltage fault or warning has occurred |
| | b14 – IOUT/POUT | | | | | An Output current or power fault or warning has occurred. |
| | b13 – INPUT | | | | | An input voltage, current or power fault or warning as occurred. |
| | b12 – MFR | | | | | A manufacturer specific fault or warning has occurred. |
| | b11 – POWER_OK# | | | | | The POWER_OK signal is de-asserted |
| | b10 - FANS | | | | | A fan or airflow fault or warning has occurred. |
| | b9 – OTHER | | | | | A bit in STATUS_OTHER is set. |
| | b8 – UKNOWN | | | | | A fault type not given in bits [15:1] of the STATUS_WORD has been detected. |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under-voltage fault has occurred |
| | b2 – TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE_OF_THE_ABOVE | | | | | A fault or warning not listed in bits[7:1] of this byte has occurred. |
| 7Ah | STATUS_VOUT | 00h | R/W | 1 | Bitmapped | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |

# PMBus™ SPECIFICATIONS

The CNS653-M Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Ah | STATUS_IOUT | 00h | R/W | 1 | Bitmapped | Output Current related faults and warnings |
| | b7 | | | | | IOUT Over current Fault |
| | b6 | | | | | IOUT Over current And Low Voltage shutdown Fault |
| | b5 | | | | | IOUT Overcurrent Warning |
| | b4 | | | | | IOUT Undercurrent Fault |
| | b3 | | | | | Current Share Fault Set if Ishare level is much greater or lower than the actual output current. Refer to Output Specifications (Table 3) for Current sharing limits. |
| | b2 | | | | | Power Limiting |
| | b1 | | | | | POUT Overpower Fault |
| | b0 | | | | | POUT Overpower Warning |
| 7Bh | STATUS_INPUT | 00h | R/W | 1 | Bitmapped | Input related faults and warnings |
| | b7 | | | | | VIN Overvoltage Fault |
| | b6 | | | | | VIN Overvoltge Warning |
| | b5 | | | | | VIN Undervoltage Warning |
| | b4 | | | | | VIN Undervoltage Fault |
| | b3 | | | | | Unit is OFF for insufficient Input Voltage |
| | b2 | | | | | IIN Overcurrent Fault |
| | b1 | | | | | IIN Overcurrent Warning |
| | b0 | | | | | PIN overpower Warning |
| 7Ch | STATUS_VOUT | 00h | R/W | 1 | Bitmapped | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |
| 7Dh | STATUS_TEMPERATURE | 00h | R/W | 1 | Bitmapped | Temperature related faults and warnings |
| | b7 | | | | | Overtemperature Fault |
| | b6 | | | | | Overtemperature Warning |
| | b5 | | | | | Undertemperature Warning |
| | B4 | | | | | Undertemperature Fault |
| | b3:0 | | | | | Beserved |

# PMBus™ SPECIFICATIONS

The CNS653-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Eh | STATUS_CML | 00h | R/W | 1 | | Communications, Logic and Memory |
| | b7 | | | | | Invalid or unsupported Command Received |
| | b6 | | | | | |
| | b5 | | | | | Packet Error Check Failed |
| | b4 | | | | | Memory Fault Detect, CRC Error |
| | b3 | | | | | |
| | b2 | | | | | |
| | b1 | | | | | |
| | b0 | | | | | |
| 80h | STATUS_MFR_SPECIFIC | 00h | R/W | 1 | Bitmapped | Manufacturer Status codes |
| | b7 | | | | | Bulk OK, 1- Bulk is within range and is ready for use |
| | b6 | | | | | Not Used |
| | b5 | | | | | Not Used |
| | b4 | | | | | Not Used |
| | b3 | | | | | Not Uesd |
| | b2 | | | | | Not Uesd |
| | b1 | | | | | Standby Fault, 1 If there's a standby fault. |
| | b0 | | | | | INH_EN Pin Status 1 – asserted, 0 - deasserted |
| 81h | STATUS_FANS_1_2 | 00h | R/W | 1 | Bitmapped | |
| | b7 | | | | | Fan 1 Fault |
| | b6 | | | | | Fan 2 Fault |
| | b5 | | | | | Fan 1 Warning |
| | b4 | | | | | Fan 2 Warning |
| | b3 | | | | | Fan_1 Speed Overridden |
| | b2 | | | | | Fan_2 Speed Overridden |
| | b1 | | | | | |
| | b0 | | | | | |
| 8Bh | READ_VOUT | 12.1 | R | 2 | Linear | Returns the actual voltage in volt<br>"11.76-12.24V" CNS653-M(U, E, F)<br>"23.52-24.48V" CNS655-MU<br>"47.04-48.96V" CNS658-MU |
| 8Ch | READ_IOUT | 0.05 | R | 2 | Linear | Returns the output current in amperes.<br>"0-54.16A" CNS653-M(U, E, F)<br>"0-27.08V" CNS655-MU<br>"0-13.54V" CNS658-MU |
| 90h | READ_FAN_SPEED_1 | - | R | 2 | Linear | Speed of Fan |
| 96h | READ_POUT | 1 | R | 2 | Linear | Returns the output power in Watts. |

# PMBus™ SPECIFICATIONS

The CNS653-M Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 98h | PMBUS_REVISION | 22h | R | 1 | Linear | Reads the PMBus revision |
| | b7:5 | | | | | Part 1 Revision<br>0000 – Revision 1.0<br>0001 – Revision 1.1 |
| | b4:0 | | | | | Part 2 Revision0000 – Revision 1.00001 – Revision 1.1 |
| 99h | MFR_ID | ARTESYN | BR | Varies | ASCII | Abbrev or symbol of manufacturers name.(“ARTESYN”) |
| 9Ah | MFR_MODEL | CNS653-MU | BR | 15 | ASCII | Manufacturers Model number, ASCII format ”CNS653-MU/F/E” |
| 9Bh | MFR_REVISION | AT | BR | Varies | ASCII | Manufacturers, revision number, ASCII format “AA” |
| 9Ch | MFR_LOCATION | Philippines | BR | Varies | ASCII | Manufacturers facility, ASCII format : Philippines” |
| 9Dh | MFR_Data | YYMMDD | BR | Varies | ASCII | Manufacture Date, ASCII format structure : “YYMMDD” |
| 9Eh | MFR_SERIAL | L84202003ZATC | BR | Varies | ASCII | Unit serial number, ASCII format “L842WWSSSSRRP000” |
| A0h | MFR_VIN_MIN | 90 | R | 2 | Linear | Minimum Input Voltage (90Vac) |
| A1h | MFR_VIN_MAX | 264 | R | 2 | Linear | Maximum Input Voltage (264Vac) |
| A2h | MFR_IIN_MAX | 9.2 | R | 2 | Linear | Maximum Input Current (9.2A) |
| A3h | MFR_PIN_MAX | 828 | R | 2 | Linear | Maximum Input Power (828W) |
| A4h | MFR_VOUT_MIN | 12 | R | 2 | Linear | Minimum Output Voltage Regulation Window<br>“12V” CNS653-M(U, E, F)<br>“24V” CNS655-MU<br>“48V” CNS658-MU |
| A5h | MFR_VOUT_MAX | 13.8 | R | 2 | Linear | Maximum Output Voltage. Regulation Window<br>“13.8V” CNS653-M(U, E, F)<br>“27.6V” CNS655-MU<br>“55.2V” CNS658-MU |
| A6h | MFR_IOUT_MAX | 54.16 | R | 2 | Linear | Maximum Output Current<br>“54.16A” CNS653-M(U, E, F)<br>“27.08V” CNS655-MU<br>“13.54V” CNS658-MU |
| A7h | MFR_POUT_MAX | 650 | R | 2 | Linear | Maximum Output Power (650W) |
| A8h | MFR_TAMBIENT_MAX | 50 | R | 2 | Linear | Maximum Operating Ambient Temperature (Secondary Ambient) (50 degC) |
| A9h | MFR_TAMBIENT_MIN | -20 | R | 2 | Linear | Minimum Operating Ambient Temperature (Secondary Ambient) (-20 degC) |
| AAh | MFR_EFFICIENCY_LL | | BR | 14 | Linear | “115, 330, 91, 650, 90, 650, 90” |
| ABh | MFR_EFFICIENCY_HL | | BR | 14 | Linear | “230, 330, 92.5, 650, 92.5, 650, 92.5” |
| B0h | USER_DATA_00 | - | | 2 | Hex | |
| E0h | FW_PRI_VERSION | 00.00.00 | BR | 8 | ASCII | |
| E1h | FW_SEC_VERSION | 02.08.00 | BR | 8 | ASCII | |

# PMBus™ SPECIFICATIONS

The CNS653-M Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| F1h | ISP_UNLOCK_CODE | 00h,00h,00h,00h | BR/W | 4 | ASCII | |
| F2h | ISP_CTRL_CMD | | R/W | 1 | Bitmapped | |
| F3h | ISP_CONFIG_STATUS | 00h | R | 2 | Bitmapped | |
| F4h | ISP_FLASH_ADDR | | BR/W | 4 | Raw Hex | |
| F5h | ISP_FLASH_DATA | | BR/W | 16 | Raw Hex | |

# PMBus™ SPECIFICATIONS

The CNS655-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 3Bh | FAN_COMMAND_1 | 0 | R/W | 2 | Linear | Adjusts the operation of the Fans. The device may override the command, if it requires higher value, to maintain proper device temperature.<br>RPM Control – Commands Speeds from 0-11000 RPM.<br>Duty cycle Control – Commands Speeds from 0 to 100% |
| 40h | VOUT_OV_FAULT_LIMIT | 32.3 | R | 2 | Linear | Sets Output Over voltage threshold. (130% to 150% of Vout) |
| 42h | VOUT_OV_WARN_LIMIT | 30 | R | 2 | Linear | Sets Over-voltage Warning threshold. (120% to 130% of Vout) |
| 43h | VOUT_UV_WARN_LIMIT | 20.4 | R | 2 | Linear | Sets Under-voltage Warning threshold. (80% to 90% of Vout) |
| 44h | VOUT_UV_FAULT_LIMIT | 18 | R | 2 | Linear | Sets Under-voltage Fault threshold. (60% to 80% of Vout) |
| 46h | IOUT_OC_FAULT_LIMIT | 32.5 | R/W | 2 | Linear | Sets the Over current threshold in Amps. (50% to 130% of Max Load) |
| 47h | IOUT_OC_FAULT_RESPONSE | 40h | R | 1 | Bitmapped | OCP ride through. If OCP persists. |
| 4Ah | IOUT_OC_WARN_LIMIT | 29.2 | R | 2 | Linear | Sets the Over Current Warning threshold in Amps. (105% to 120% of Max Load) |
| 4Fh | OT_FAULT_LIMIT | 120 | R | 2 | Linear | Secondary ambient temperature Fault threshold, in degree C. (120 degC) |
| 51h | OT_WARN_LIMIT | 115 | R | 2 | Linear | Secondary ambient temperature warning threshold, in degree C. Operating limit. refer to section 3.1. (115 degC) |
| 59h | VIN_UV_FAULT_LIMIT | 80 | R | 2 | Linear | (80Vac) |
| 6Ah | POUT_OP_WARN_LIMIT | 715 | R | 2 | Linear | 715W |
| 78h | STATUS_BYTE | 00h | R | 1 | Bitmapped | Returns the summary of critical faults |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under--voltage fault has occurred |
| | b2 - TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE OF THE ABOVE | | | | | A Fault Warning not listed in bits[7:1] has occurred. |

# PMBus™ SPECIFICATIONS

The CNS655-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 79h | STATUS_WORD | 0000h | R | 2 | | Summary of units Fault and warning status. |
| | b15 – VOUT | | | | | An output voltage fault or warning has occurred |
| | b14 – IOUT/POUT | | | | | An Output current or power fault or warning has occurred. |
| | b13 – INPUT | | | | | An input voltage, current or power fault or warning as occurred. |
| | b12 – MFR | | | | | A manufacturer specific fault or warning has occurred. |
| | b11 – POWER_OK# | | | | | The POWER_OK signal is de-asserted |
| | b10 - FANS | | | | | A fan or airflow fault or warning has occurred. |
| | b9 – OTHER | | | | | A bit in STATUS_OTHER is set. |
| | b8 – UKNOWN | | | | | A fault type not given in bits [15:1] of the STATUS_WORD has been detected. |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under-voltage fault has occurred |
| | b2 – TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE_OF_THE_ABOVE | | | | | A fault or warning not listed in bits[7:1] of this byte has occurred. |
| 7Ah | STATUS_VOUT | 00h | R/W | 1 | Bitmapped | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |

# PMBus™ SPECIFICATIONS

The CNS655-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Ah | STATUS_IOUT | 00h | R/W | 1 | Bitmapped | Output Current related faults and warnings |
| | b7 | | | | | IOUT Over current Fault |
| | b6 | | | | | IOUT Over current And Low Voltage shutdown Fault |
| | b5 | | | | | IOUT Overcurrent Warning |
| | b4 | | | | | IOUT Undercurrent Fault |
| | b3 | | | | | Current Share Fault Set if Ishare level is much greater or lower than the actual output current. Refer to Output Specifications (Table 3) for Current sharing limits. |
| | b2 | | | | | Power Limiting |
| | b1 | | | | | POUT Overpower Fault |
| | b0 | | | | | POUT Overpower Warning |
| 7Bh | STATUS_INPUT | 00h | R/W | 1 | Bitmapped | Input related faults and warnings |
| | b7 | | | | | VIN Overvoltage Fault |
| | b6 | | | | | VIN Overvoltge Warning |
| | b5 | | | | | VIN Undervoltage Warning |
| | b4 | | | | | VIN Undervoltage Fault |
| | b3 | | | | | Unit is OFF for insufficient Input Voltage |
| | b2 | | | | | IIN Overcurrent Fault |
| | b1 | | | | | IIN Overcurrent Warning |
| | b0 | | | | | PIN overpower Warning |
| 7Ch | STATUS_VOUT | 00h | R/W | 1 | Bitmapped | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |
| 7Dh | STATUS_TEMPERATURE | 00h | R/W | 1 | Bitmapped | Temperature related faults and warnings |
| | b7 | | | | | Overtemperature Fault |
| | b6 | | | | | Overtemperature Warning |
| | b5 | | | | | Undertemperature Warning |
| | B4 | | | | | Undertemperature Fault |
| | b3:0 | | | | | Beserved |

# PMBus™ SPECIFICATIONS

The CNS655-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Eh | STATUS_CML | 00h | R/W | 1 | | Communications, Logic and Memory |
| | b7 | | | | | Invalid or unsupported Command Received |
| | b6 | | | | | |
| | b5 | | | | | Packet Error Check Failed |
| | b4 | | | | | Memory Fault Detect, CRC Error |
| | b3 | | | | | |
| | b2 | | | | | |
| | b1 | | | | | |
| | b0 | | | | | |
| 80h | STATUS_MFR_SPECIFIC | 00h | R/W | 1 | Bitmapped | Manufacturer Status codes |
| | b7 | | | | | Bulk OK, 1- Bulk is within range and is ready for use |
| | b6 | | | | | Not Used |
| | b5 | | | | | Not Used |
| | b4 | | | | | Not Used |
| | b3 | | | | | Not Uesd |
| | b2 | | | | | Not Uesd |
| | b1 | | | | | Standby Fault, 1 If there's a standby fault. |
| | b0 | | | | | INH_EN Pin Status 1 – asserted, 0 - deasserted |
| 81h | STATUS_FANS_1_2 | 00h | R/W | 1 | Bitmapped | |
| | b7 | | | | | Fan 1 Fault |
| | b6 | | | | | Fan 2 Fault |
| | b5 | | | | | Fan 1 Warning |
| | b4 | | | | | Fan 2 Warning |
| | b3 | | | | | Fan_1 Speed Overridden |
| | b2 | | | | | Fan_2 Speed Overridden |
| | b1 | | | | | |
| | b0 | | | | | |
| 8Bh | READ_VOUT | 24.17 | R | 2 | Linear | Returns the actual voltage in volt<br>"11.76-12.24V" CNS653-M(U, E, F)<br>"23.52-24.48V" CNS655-MU<br>"47.04-48.96V" CNS658-MU |
| 8Ch | READ_IOUT | 0.12 | R | 2 | Linear | Returns the output current in amperes.<br>"0-54.16A" CNS653-M(U, E, F)<br>"0-27.08V" CNS655-MU<br>"0-13.54V" CNS658-MU |
| 90h | READ_FAN_SPEED_1 | - | R | 2 | Linear | Speed of Fan |
| 96h | READ_POUT | 3 | R | 2 | Linear | Returns the output power in Watts. |

# PMBus™ SPECIFICATIONS

The CNS655-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 98h | PMBUS_REVISION | 22h | R | 1 | Linear | Reads the PMBus revision |
| | b7:5 | | | | | Part 1 Revision<br>0000 – Revision 1.0<br>0001 – Revision 1.1 |
| | b4:0 | | | | | Part 2 Revision0000 – Revision 1.00001 – Revision 1.1 |
| 99h | MFR_ID | ARTESYN | BR | Varies | ASCII | Abbrev or symbol of manufacturers name.(“ARTESYN”) |
| 9Ah | MFR_MODEL | CNS655-MU | BR | 15 | ASCII | Manufacturers Model number, ASCII format ”CNS655-MU” |
| 9Bh | MFR_REVISION | AP | BR | Varies | ASCII | Manufacturers, revision number, ASCII format “AA” |
| 9Ch | MFR_LOCATION | Philippines | BR | Varies | ASCII | Manufacturers facility, ASCII format : Philippines” |
| 9Dh | MFR_Data | YYMMDD | BR | Varies | ASCII | Manufacture Date, ASCII format structure : “YYMMDD” |
| 9Eh | MFR_SERIAL | L8461N0059APC | BR | Varies | ASCII | Unit serial number, ASCII format “L842WWSSSSRRP000” |
| A0h | MFR_VIN_MIN | 90 | R | 2 | Linear | Minimum Input Voltage (90Vac) |
| A1h | MFR_VIN_MAX | 264 | R | 2 | Linear | Maximum Input Voltage (264Vac) |
| A2h | MFR_IIN_MAX | 9.2 | R | 2 | Linear | Maximum Input Current (9.2A) |
| A3h | MFR_PIN_MAX | 828 | R | 2 | Linear | Maximum Input Power (828W) |
| A4h | MFR_VOUT_MIN | 48 | R | 2 | Linear | Minimum Output Voltage Regulation Window<br>“12V” CNS653-M(U, E, F)<br>“24V” CNS655-MU<br>“48V” CNS658-MU |
| A5h | MFR_VOUT_MAX | 55.2 | R | 2 | Linear | Maximum Output Voltage. Regulation Window<br>“13.8V” CNS653-M(U, E, F)<br>“27.6V” CNS655-MU<br>“55.2V” CNS658-MU |
| A6h | MFR_IOUT_MAX | 27.09 | R | 2 | Linear | Maximum Output Current<br>“54.16A” CNS653-M(U, E, F)<br>“27.08V” CNS655-MU<br>“13.54V” CNS658-MU |
| A7h | MFR_POUT_MAX | 650 | R | 2 | Linear | Maximum Output Power (650W) |
| A8h | MFR_TAMBIENT_MAX | 50 | R | 2 | Linear | Maximum Operating Ambient Temperature (Secondary Ambient) (50 degC) |
| A9h | MFR_TAMBIENT_MIN | -20 | R | 2 | Linear | Minimum Operating Ambient Temperature (Secondary Ambient) (-20 degC) |
| AAh | MFR_EFFICIENCY_LL | | BR | 14 | Linear | “115, 330, 91, 650, 90, 650, 90” |
| ABh | MFR_EFFICIENCY_HL | | BR | 14 | Linear | “230, 330, 92.5, 650, 92.5, 650, 92.5” |
| B0h | USER_DATA_00 | - | | 2 | Hex | |
| E0h | FW_PRI_VERSION | 00.00.00 | BR | 8 | ASCII | |
| E1h | FW_SEC_VERSION | 02.06.00 | BR | 8 | ASCII | |

# PMBus™ SPECIFICATIONS

The CNS655-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| F1h | ISP_UNLOCK_CODE | 00h,00h,00h,00h | BR/W | 4 | ASCII | |
| F2h | ISP_CTRL_CMD | | R/W | 1 | Bitmapped | |
| F3h | ISP_CONFIG_STATUS | 00h | R | 2 | Bitmapped | |
| F4h | ISP_FLASH_ADDR | | BR/W | 4 | Raw Hex | |
| F5h | ISP_FLASH_DATA | | BR/W | 16 | Raw Hex | |

# PMBus™ SPECIFICATIONS

The CNS658-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 00h | PAGE | 00h | R | 1 | Hex | |
| 01h | OPERATION | 80h | R/W | 1 | Bitmapped | Used to turn the unit ON/OFF in conjunction with the input INH_EN pin. |
| | b7:6 | 10 | | | | 01 – Soft Turn OFF (With Sequencing)<br>10 - PSU ON |
| | b5:4 | 00 | | | | |
| | b3:2 | 00 | | | | |
| | b1:0 | 00 | | | | Reserved |
| 02h | ON_OFF_CONFIG | 1Eh | R | 1 | Bitmapped | Configures the combination of INH_EN pin and serial communication commands needed to turn the unit ON/OFF. |
| | b7:5 | 000 | | | | Reserved |
| | b4 – Enable INH_EN pin and Serial communication control. | 1 | | | | 0 – Unit powers up any time power is present regardless of the state of INH_EN pin.<br>1 – Unit powers up as dictated by INH_EN pin and OPERATION command (b3:0) . |
| | b3 – Serial communication Control | 1 | | | | 0 – Unit Ignores ON/OFF portion of the OPERATION command.<br>1 – Enables Serial communication ON/OFF portion of OPERATION command.<br>Requires INH_EN pin to be asserted for the unit to start and energize the output. |
| | b2 – Sets how the unit responds to INH_EN pin | 1 | | | | 0 – Unit ignores INH_EN pin. (ON/OFF controlled by OPERATION command).<br>1 – Unit requires INH_EN pin to be asserted to start the unit. |
| | b1 – INH_EN pin polarity | 1 | | | | 0 – Active Low (Pull Low to start the unit).<br>1 – Active high (Pull high to start the unit). |
| | b0 – INH_ENL pin action | 0 | | | | 0 – Use programmed turn ON/OFF delay.<br>1 – Turn OFF the output and stop transferring energy to the output as fast as possible. |
| 03h | CLEAR_FAULTS | 00 | S | | N/A | |
| 10h | WRITE_PROTECT | 80h | R/W | 1 | Bitmapped | Used to Control Writing to the PMBus Device<br>80h – Disables write except 10h<br>40h – Disables write except 10h, 01h, 00h<br>20h – Disables write except 10h, 01h, 00h, 02h and 21h<br>00 – Enables write to all writeable commands. |

# PMBus™ SPECIFICATIONS

The CNS658-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 15h | STORE_USER_ALL | - | S | 0 | | Copies the Operating memory table to the matching USER non-volatile memory. |
| 1Bh | SMBALERT_MASK | | | 2 | Bitmapped | |
| 20h | VOUT_MODE | 17h | R | 1 | Bitmapped | Specifies the mode and parameters of Output Voltage related Data Formats |
| 21h | VOUT_COMMAND | 48.1 | R/W | 2 | Linear | Sets the Output Voltage Reference<br>“12V” CNS653-M(U, E, F)<br>“24V” CNS655-MU<br>“48V” CNS658-MU<br>Vout command sends discreet value to change<br>or trim output voltage. The value acts as Digital reference of the Power supply after additional operations are performed (to make the representation compatible).<br>“12-13.8V” CNS653-M(U, E, F)<br>“24-27.6V” CNS655-MU<br>“48-55.2V” CNS658-MU<br>Affects OVP_WARNING and FAULT LIMIT, as well as POWER_OK_ON/OFF level. |
| 24h | VOUT_MAX | 55.2 | R | 2 | Linear | Sets the max adjustable output voltage limit. “13.8V” CNS653-M(U, E, F)<br>“27.6V” CNS655-MU<br>“55.2V” CNS658-MU |
| 35h | VIN_ON | 90 | R | 2 | Linear | 90 Vac |
| 36h | VIN_OFF | 80 | R | 2 | Linear | 80 Vac |
| 3Ah | FAN_ CONFIG_1_2 | 90h | R | 1 | Bitmapped | Used to configure up to 2 fans associated with one PMBus device |
| | b7 | 1 | | | | 1 – Fan is installed in position 1<br>0 – No Fan installed in position 1 |
| | b6 | 0 | | | | 1 – Fan is commanded in RPM<br>0 – Fan is commanded in DC |
| | b5:4 | 01 | | | | 00 – 1 pulse per revolution<br>01 – 2 pulses per revolution<br>10 – 3 pulses per revolution<br>11 – 4 pulses per revolution |
| | b3 | 0 | | | | 1 – Fan is installed in position 2<br>0 – No Fan installed in position 2 |
| | b2 | 0 | | | | 1 – Fan is commanded in RPM<br>0 – Fan is commanded in DC |
| | b1:0 | 00 | | | | 00 – 1 pulse per revolution<br>01 – 2 pulses per revolution<br>10 – 3 pulses per revolution<br>11 – 4 pulses per revolution |

# PMBus™ SPECIFICATIONS

The CNS658-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 3Bh | FAN_COMMAND_1 | 0 | R/W | 2 | Linear | Adjusts the operation of the Fans. The device may override the command, if it requires higher value, to maintain proper device temperature.<br>RPM Control – Commands Speeds from 0-11000 RPM.<br>Duty cycle Control – Commands Speeds from 0 to 100% |
| 40h | VOUT_OV_FAULT_LIMIT | 63.2 | R | 2 | Linear | Sets Output Over voltage threshold. (130% to 150% of Vout) |
| 42h | VOUT_OV_WARN_LIMIT | 60 | R | 2 | Linear | Sets Over-voltage Warning threshold. (120% to 130% of Vout) |
| 43h | VOUT_UV_WARN_LIMIT | 40.8 | R | 2 | Linear | Sets Under-voltage Warning threshold. (80% to 90% of Vout) |
| 44h | VOUT_UV_FAULT_LIMIT | 36 | R | 2 | Linear | Sets Under-voltage Fault threshold. (60% to 80% of Vout) |
| 46h | IOUT_OC_FAULT_LIMIT | 16.2 | R/W | 2 | Linear | Sets the Over current threshold in Amps. (50% to 130% of Max Load) |
| 47h | IOUT_OC_FAULT_RESPONSE | 40h | R | 1 | Bitmapped | OCP ride through. If OCP persists. |
| 4Ah | IOUT_OC_WARN_LIMIT | 14.6 | R | 2 | Linear | Sets the Over Current Warning threshold in Amps. (105% to 120% of Max Load) |
| 4Fh | OT_FAULT_LIMIT | 120 | R | 2 | Linear | Secondary ambient temperature Fault threshold, in degree C. (120 degC) |
| 51h | OT_WARN_LIMIT | 115 | R | 2 | Linear | Secondary ambient temperature warning threshold, in degree C. Operating limit. refer to section 3.1. (115 degC) |
| 59h | VIN_UV_FAULT_LIMIT | 80 | R | 2 | Linear | (80Vac) |
| 6Ah | POUT_OP_WARN_LIMIT | 715 | R | 2 | Linear | 715W |
| 78h | STATUS_BYTE | 00h | R | 1 | Bitmapped | Returns the summary of critical faults |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under--voltage fault has occurred |
| | b2 - TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE OF THE ABOVE | | | | | A Fault Warning not listed in bits[7:1] has occurred. |

# PMBus™ SPECIFICATIONS

The CNS658-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 79h | STATUS_WORD | 0000h | R | 2 | | Summary of units Fault and warning status. |
| | b15 – VOUT | | | | | An output voltage fault or warning has occurred |
| | b14 – IOUT/POUT | | | | | An Output current or power fault or warning has occurred. |
| | b13 – INPUT | | | | | An input voltage, current or power fault or warning as occurred. |
| | b12 – MFR | | | | | A manufacturer specific fault or warning has occurred. |
| | b11 – POWER_OK# | | | | | The POWER_OK signal is de-asserted |
| | b10 - FANS | | | | | A fan or airflow fault or warning has occurred. |
| | b9 – OTHER | | | | | A bit in STATUS_OTHER is set. |
| | b8 – UKNOWN | | | | | A fault type not given in bits [15:1] of the STATUS_WORD has been detected. |
| | b7 – BUSY | | | | | A fault was declared because the device was busy and unable to respond. |
| | b6 – OFF | | | | | Unit is OFF |
| | b5 – VOUT_OV | | | | | Output over-voltage fault has occurred |
| | b4 – IOUT_OC | | | | | Output over-current fault has occurred |
| | b3 - VIN_UV | | | | | An input under-voltage fault has occurred |
| | b2 – TEMPERATURE | | | | | A temperature fault or warning has occurred |
| | b1 – CML | | | | | A communication, memory or logic fault has occurred. |
| | b0 – NONE_OF_THE_ABOVE | | | | | A fault or warning not listed in bits[7:1] of this byte has occurred. |
| 7Ah | STATUS_VOUT | 00h | R/W | 1 | Bitmapped | Output voltage related faults and warnings |
| | b7 | | | | | VOUT Over--voltage Fault |
| | b6 | | | | | VOUT Over-voltage warning |
| | b5 | | | | | VOUT Under-voltage Warning |
| | b4 | | | | | VOUT Under-voltage Fault |
| | b3 | | | | | VOUT_MAX Warning, an attempt has been made to set output to a value higher that the highest permissible voltage. |
| | b2 | | | | | TON_MAX_FAULT |
| | b1 | | | | | TOFF_MAX Warning |
| | b0 | | | | | reserved |

# PMBus™ SPECIFICATIONS

The CNS658-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 7Bh | STATUS_IOUT | 00h | R/W | 1 | Bitmapped | Output Current related faults and warnings |
| | b7 | | | | | IOUT Over current Fault |
| | b6 | | | | | IOUT Over current And Low Voltage shutdown Fault |
| | b5 | | | | | IOUT Overcurrent Warning |
| | b4 | | | | | IOUT Undercurrent Fault |
| | b3 | | | | | Current Share Fault Set if Ishare level is much greater or lower than the actual output current. Refer to Output Specifications (Table 3) for Current sharing limits. |
| | b2 | | | | | Power Limiting |
| | b1 | | | | | POUT Overpower Fault |
| | b0 | | | | | POUT Overpower Warning |
| 7Ch | STATUS_INPUT | 00h | R/W | 1 | Bitmapped | Input related faults and warnings |
| | b7 | | | | | VIN Overvoltage Fault |
| | b6 | | | | | VIN Overvoltge Warning |
| | b5 | | | | | VIN Undervoltage Warning |
| | b4 | | | | | VIN Undervoltage Fault |
| | b3 | | | | | Unit is OFF for insufficient Input Voltage |
| | b2 | | | | | IIN Overcurrent Fault |
| | b1 | | | | | IIN Overcurrent Warning |
| | b0 | | | | | PIN overpower Warning |
| 7Dh | STATUS_TEMPERATURE | 00h | R/W | 1 | Bitmapped | Temperature related faults and warnings |
| | b7 | | | | | Over temperature Fault |
| | b6 | | | | | Over temperature Warning |
| | b5 | | | | | Under temperature Warning |
| | B4 | | | | | Under temperature Fault |
| | b3:0 | | | | | Reserved |
| 7Eh | STATUS_CML | 00h | R/W | 1 | | Communications, Logic and Memory |
| | b7 | | | | | Invalid or unsupported Command Received |
| | b6 | | | | | |
| | b5 | | | | | Packet Error Check Failed |
| | b4 | | | | | Memory Fault Detect, CRC Error |
| | b3 | | | | | |
| | b2 | | | | | |
| | b1 | | | | | |
| | b0 | | | | | |

# PMBus™ SPECIFICATIONS

The CNS658-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 80h | STATUS_MFR_SPECIFIC | 00h | R/W | 1 | Bitmapped | Manufacturer Status codes |
| | b7 | | | | | Bulk OK, 1- Bulk is within range and is ready for use |
| | b6 | | | | | Not Used |
| | b5 | | | | | Not Used |
| | b4 | | | | | Not Used |
| | b3 | | | | | Not Uesd |
| | b2 | | | | | Not Uesd |
| | b1 | | | | | Standby Fault, 1 If there's a standby fault. |
| | b0 | | | | | INH_EN Pin Status 1 – asserted, 0 - deasserted |
| 81h | STATUS_FANS_1_2 | 00h | R/W | 1 | Bitmapped | |
| | b7 | | | | | Fan 1 Fault |
| | b6 | | | | | Fan 2 Fault |
| | b5 | | | | | Fan 1 Warning |
| | b4 | | | | | Fan 2 Warning |
| | b3 | | | | | Fan_1 Speed Overridden |
| | b2 | | | | | Fan_2 Speed Overridden |
| | b1 | | | | | |
| | b0 | | | | | |
| 8Bh | READ_VOUT | 48.15 | R | 2 | Linear | Returns the actual voltage in volt<br>"11.76-12.24V" CNS653-M(U, E, F)<br>"23.52-24.48V" CNS655-MU<br>"47.04-48.96V" CNS658-MU |
| 8Ch | READ_IOUT | 0 | R | 2 | Linear | Returns the output current in amperes.<br>"0-54.16A" CNS653-M(U, E, F)<br>"0-27.08V" CNS655-MU<br>"0-13.54V" CNS658-MU |
| 8Dh | READ_TEMPERATURE_1 | - | R | 2 | Linear | PRI FAN GPIOB2 (120degC) |
| 8Eh | READ_TEMPERATURE_2 | - | R | 2 | Linear | ORING GPIOB3 (130degC) |
| 8Fh | READ_TEMPERATURE_3 | - | R | 2 | Linear | SYNC RECT GPIOB4 (140degC) |
| 90h | READ_FAN_SPEED_1 | - | R | 2 | Linear | Speed of Fan |
| 96h | READ_POUT | 0 | R | 2 | Linear | Returns the output power in Watts. |
| 98h | PMBUS_REVISION | 22h | R | 1 | Linear | Reads the PMBus revision |
| | b7:5 | | | | | Part 1 Revision<br>0000 – Revision 1.0<br>0001 – Revision 1.1 |
| | b4:0 | | | | | Part 2 Revision0000 – Revision 1.00001 – Revision 1.1 |
| 99h | MFR_ID | ARTESYN | BR | Varies | ASCII | Abbrev or symbol of manufacturers name.("ARTESYN") |
| 9Ah | MFR_MODEL | CNS658-MU | BR | 15 | ASCII | Manufacturers Model number, ASCII format "CNS658-MU" |
| 9Bh | MFR_REVISION | AP | BR | Varies | ASCII | Manufacturers, revision number, ASCII format "AA" |

# PMBus™ SPECIFICATIONS

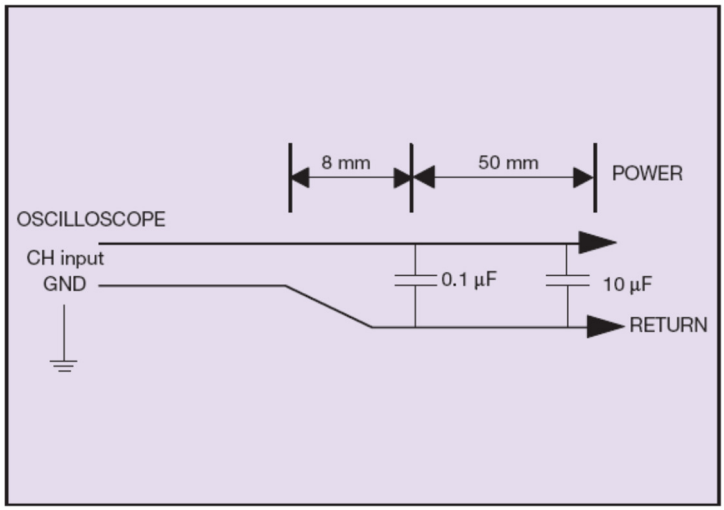
The CNS658-MU Supported PMBus™ Command List:

| Command Code | Command Name | Default Value | Access Type | Data Bytes | Data Format | Description |
|---|---|---|---|---|---|---|
| 98h | PMBUS_REVISION | 22h | R | 1 | Linear | Reads the PMBus revision |
| 9Ch | MFR_LOCATION | Philippines | BR | Varies | ASCII | Manufacturers facility, ASCII format : Philippines” |
| 9Dh | MFR_Data | YYMMDD | BR | Varies | ASCII | Manufacture Date, ASCII format structure : “YYMMDD” |
| 9Eh | MFR_SERIAL | L847VX004BAPC | BR | Varies | ASCII | Unit serial number, ASCII format “L842WWSSSSRRP000” |
| A0h | MFR_VIN_MIN | 90 | R | 2 | Linear | Minimum Input Voltage (90Vac) |
| A1h | MFR_VIN_MAX | 264 | R | 2 | Linear | Maximum Input Voltage (264Vac) |
| A2h | MFR_IIN_MAX | 9.2 | R | 2 | Linear | Maximum Input Current (9.2A) |
| A3h | MFR_PIN_MAX | 828 | R | 2 | Linear | Maximum Input Power (828W) |
| A4h | MFR_VOUT_MIN | 48 | R | 2 | Linear | Minimum Output Voltage Regulation Window<br>“12V” CNS653-M(U, E, F)<br>“24V” CNS655-MU<br>“48V” CNS658-MU |
| A5h | MFR_VOUT_MAX | 55.2 | R | 2 | Linear | Maximum Output Voltage. Regulation Window<br>“13.8V” CNS653-M(U, E, F)<br>“27.6V” CNS655-MU<br>“55.2V” CNS658-MU |
| A6h | MFR_IOUT_MAX | 13.54 | R | 2 | Linear | Maximum Output Current<br>“54.16A” CNS653-M(U, E, F)<br>“27.08V” CNS655-MU<br>“13.54V” CNS658-MU |
| A7h | MFR_POUT_MAX | 650 | R | 2 | Linear | Maximum Output Power (650W) |
| A8h | MFR_TAMBIENT_MAX | 50 | R | 2 | Linear | Maximum Operating Ambient Temperature (Secondary Ambient) (50 degC) |
| A9h | MFR_TAMBIENT_MIN | -20 | R | 2 | Linear | Minimum Operating Ambient Temperature (Secondary Ambient) (-20 degC) |
| AAh | MFR_EFFICIENCY_LL | | BR | 14 | Linear | “115, 330, 91, 650, 90, 650, 90” |
| ABh | MFR_EFFICIENCY_HL | | BR | 14 | Linear | “230, 330, 92.5, 650, 92.5, 650, 92.5” |
| B0h | USER_DATA_00 | - | | 2 | Hex | |
| E0h | FW_PRI_VERSION | | BR | 8 | ASCII | |
| E1h | FW_SEC_VERSION | | BR | 8 | ASCII | |
| F1h | ISP_UNLOCK_CODE | 00h,00h,00h,00h | BR/W | 4 | ASCII | |
| F2h | ISP_CTRL_CMD | | R/W | 1 | Bitmapped | |
| F3h | ISP_CONFIG_STATUS | 00h | R | 2 | Bitmapped | |
| F4h | ISP_FLASH_ADDR | | BR/W | 4 | Raw Hex | |
| F5h | ISP_FLASH_DATA | | BR/W | 16 | Raw Hex | |

# APPLICATION NOTES

## Output Ripple and Noise Measurement

The setup outlined in the diagram below has been used for output voltage ripple and noise measurements on the CNS650-M series. When measuring output ripple and noise, a scope jack in parallel with a 0.1uF ceramic chip capacitor, and a 10 uF aluminum electrolytic capacitor should be used. Oscilloscope should be set to 20 MHz bandwidth for this measurement.



# RECORD OF REVISION AND CHANGES

| Issue | Date | Description | Originators |
|---|---|---|---|
| 1.0 | 01.25.2017 | First Issue | E. Bai |
| 1.1 | 08.24.2017 | Remove note1 about parallel units on page 6<br>Correct the Temperature on page 15 | E. Bai |
| 1.2 | 12.04.2017 | Correct the MTBF | E. Bai |
| 1.3 | 03.14.2018 | Correct the device addressing, and I2C time out | E. Bai |
| 1.4 | 03.22.2018 | Add “Note 3 - To achieve the input power lower than 0.5W, communication and all signals are disabled and only the inhibit pin is active.” on page 4 | E. Bai |
| 1.5 | 07.05.2019 | Add detail description for fan header pins | E. Bai |
| 1.6 | 12.18.2019 | SDA, SCL external pull up resister changed to 2.2Kohm | E. Bai |
| 1.7 | 06.04.2020 | Efficiency curve, production hi-pot update, standby preload | E. Bai |
| 1.8 | 06.18.2020 | Update safety cert from 60950 to 62368-1 | E. Bai |
| 1.9 | 10.13.2020 | Delete command 8D, and I2C external pull-up resistor is changed to “recommended”, not “must” on page 32 | E. Bai |
| 2.0 | 08.25.2021 | Change the Power Factor and Harmonic conditions on page 4 | E. Bai |
| 2.1 | 09.27.2021 | PMBus Command List Check | E. Bai |
| 2.2 | 05.05.2022 | Update UKCA safety mark and delete Class II on page 23 | E. Bai |
| 2.3 | 10.08.2022 | Add note for PF at 360 to 400 Hz input frequency | E. Wang |
| 2.4 | 07.24.2023 | Change IEC 60601-1-2 4th Edition to IEC 60601-1 3.1 Edition on page 1 | E. Bai |
| 2.5 | 01.07.2025 | Change the remote sense compensation from 115% to 5V | E. Bai |
| 2.6 | 05.26.2025 | Update the PMBus command list, 7Ah, 7Bh, 7Ch. | E. Bai |

## ABOUT ADVANCED ENERGY

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For international contact information,
visit advancedenergy.com.

powersales@aei.com (Sales Support)
productsupport.ep@aei.com (Technical Support)
+1 888 412 7832

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