

## High-side/Low-side Driver ICs **MCZ5601SC**

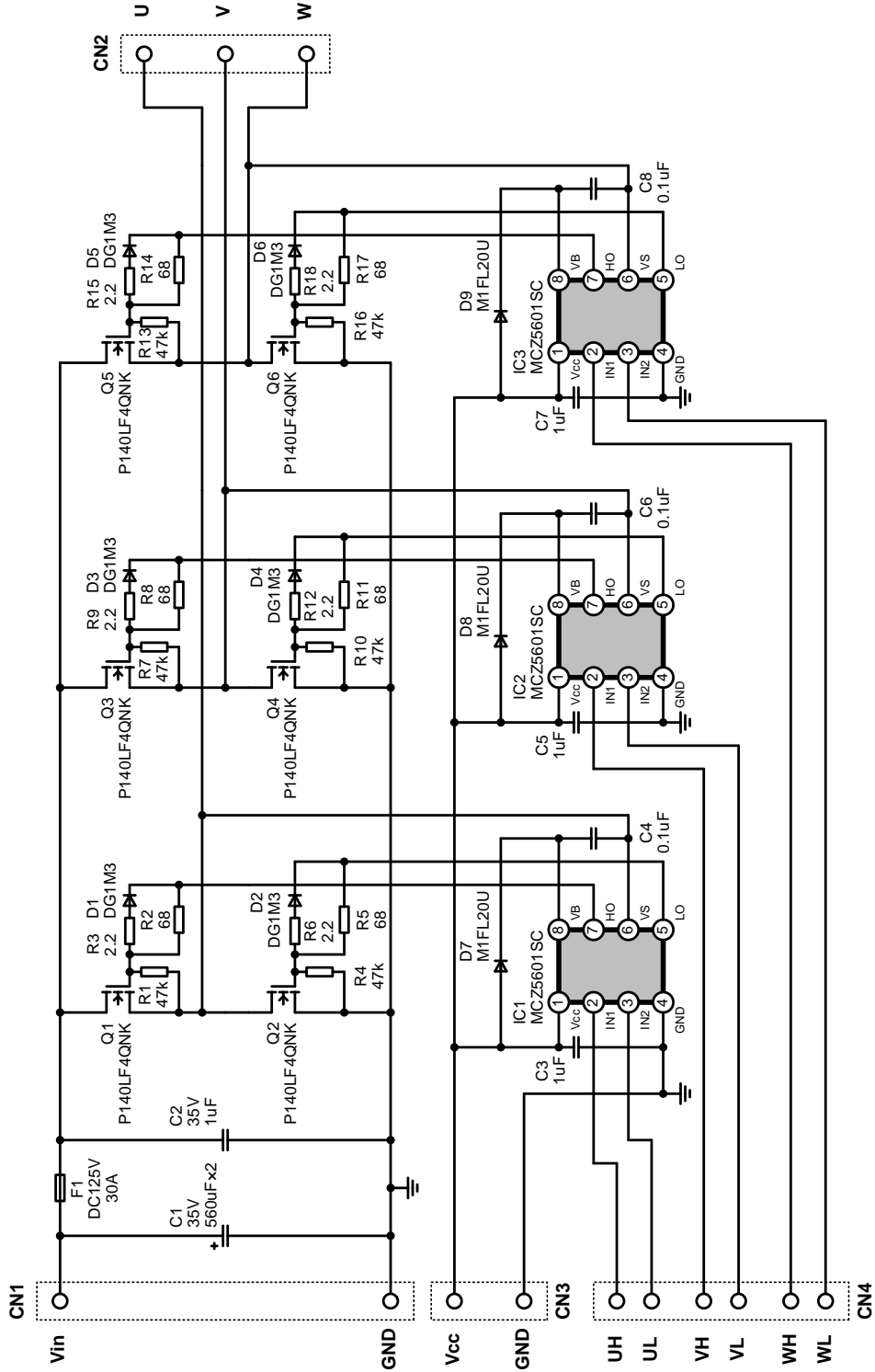
### Three-phase inverter

|                |        |
|----------------|--------|
| Input voltage  | DC 12V |
| Vcc voltage    | DC 12V |
| Output Current | 19A    |
| Output Power   | 175W   |

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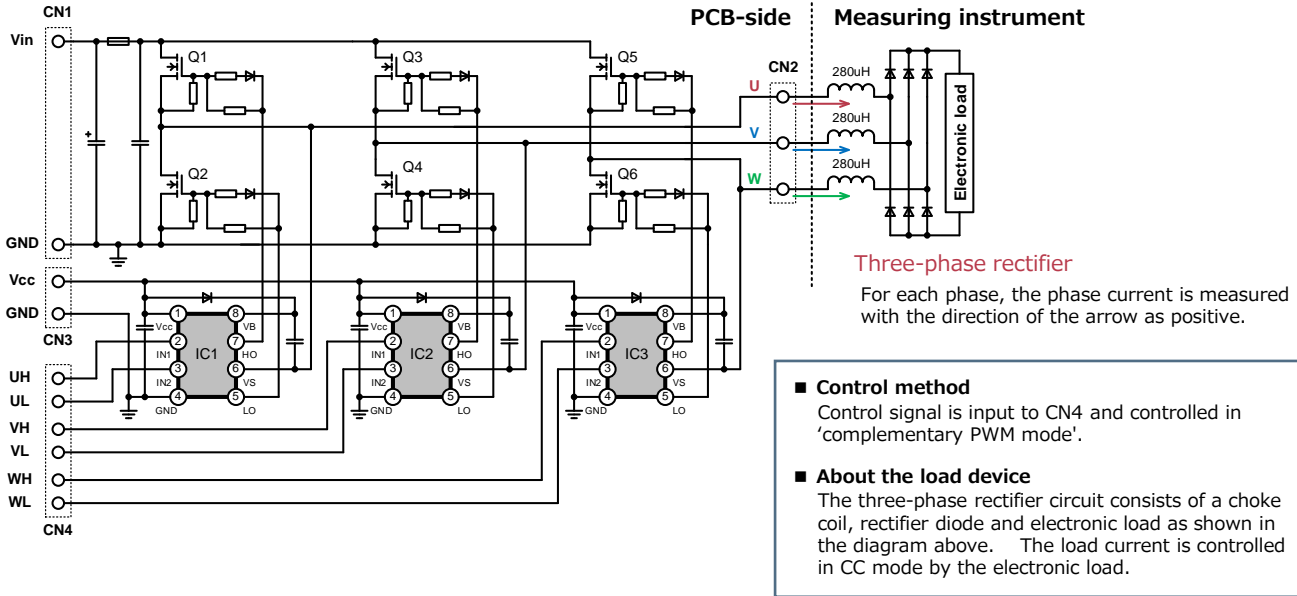
Reference circuit diagram



**Bill Of Material**

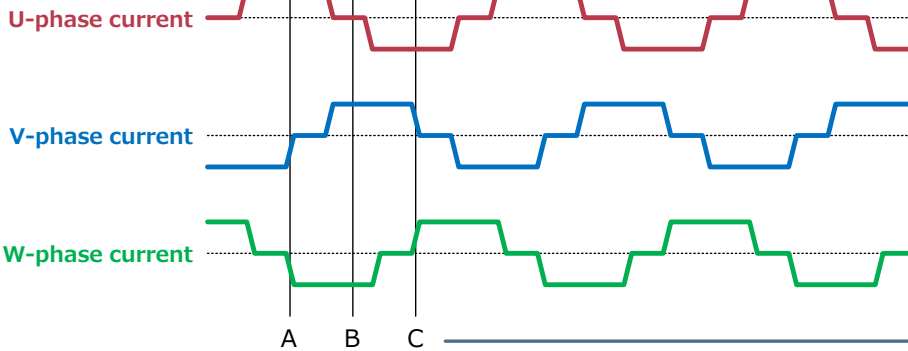
| No.  | Type                   | Qt'y | Spec   |        | Model Name     | Vendor     | Remarks |
|------|------------------------|------|--------|--------|----------------|------------|---------|
| F1   | Fuse                   | 1    | 30 A   |        | DC125VTLKR     | SOC        | -       |
| IC1  | Driver IC              | 1    | -      | -      | MCZ5601SC      | SHINDENGEN | -       |
| IC2  | Driver IC              | 1    | -      | -      | MCZ5601SC      | SHINDENGEN | -       |
| IC3  | Driver IC              | 1    | -      | -      | MCZ5601SC      | SHINDENGEN | -       |
| Q1   | Power MOSFET           | 1    | 40 V   | 140 A  | P140LF4QNK     | SHINDENGEN | -       |
| Q2   | Power MOSFET           | 1    | 40 V   | 140 A  | P140LF4QNK     | SHINDENGEN | -       |
| Q3   | Power MOSFET           | 1    | 40 V   | 140 A  | P140LF4QNK     | SHINDENGEN | -       |
| Q4   | Power MOSFET           | 1    | 40 V   | 140 A  | P140LF4QNK     | SHINDENGEN | -       |
| Q5   | Power MOSFET           | 1    | 40 V   | 140 A  | P140LF4QNK     | SHINDENGEN | -       |
| Q6   | Power MOSFET           | 1    | 40 V   | 140 A  | P140LF4QNK     | SHINDENGEN | -       |
| D1   | SBD                    | 1    | 30 V   | 1 A    | DG1M3          | SHINDENGEN | -       |
| D2   | SBD                    | 1    | 30 V   | 1 A    | DG1M3          | SHINDENGEN | -       |
| D3   | SBD                    | 1    | 30 V   | 1 A    | DG1M3          | SHINDENGEN | -       |
| D4   | SBD                    | 1    | 30 V   | 1 A    | DG1M3          | SHINDENGEN | -       |
| D5   | SBD                    | 1    | 30 V   | 1 A    | DG1M3          | SHINDENGEN | -       |
| D6   | SBD                    | 1    | 30 V   | 1 A    | DG1M3          | SHINDENGEN | -       |
| D7   | FRD                    | 1    | 200 V  | 1.1 A  | M1FL20U        | SHINDENGEN | -       |
| D8   | FRD                    | 1    | 200 V  | 1.1 A  | M1FL20U        | SHINDENGEN | -       |
| D9   | FRD                    | 1    | 200 V  | 1.1 A  | M1FL20U        | SHINDENGEN | -       |
| C1-1 | Electrolytic Capacitor | 1    | 35 V   | 560 uF | 35ZLH560M      | Rubycon    | -       |
| C1-2 | Electrolytic Capacitor | 1    | 35 V   | 560 uF | 35ZLH560M      | Rubycon    | -       |
| C2   | MLCC                   | 1    | 35 V   | 1 uF   | C2012X7R1V105K | TDK        | -       |
| C3   | MLCC                   | 1    | 35 V   | 1 uF   | C2012X7R1V105K | TDK        | -       |
| C4   | MLCC                   | 1    | 50 V   | 0.1 uF | C1608X7R1H104K | TDK        | -       |
| C5   | MLCC                   | 1    | 35 V   | 1 uF   | C2012X7R1V105K | TDK        | -       |
| C6   | MLCC                   | 1    | 50 V   | 0.1 uF | C1608X7R1H104K | TDK        | -       |
| C7   | MLCC                   | 1    | 35 V   | 1 uF   | C2012X7R1V105K | TDK        | -       |
| C8   | MLCC                   | 1    | 50 V   | 0.1 uF | C1608X7R1H104K | TDK        | -       |
| R1   | Chip Resistor          | 1    | 1/10 W | 47 kΩ  | RK73B1ETTP473J | KOA        | -       |
| R2   | Chip Resistor          | 1    | 1/10 W | 68 Ω   | RK73B1JTDD680J | KOA        | -       |
| R3   | Chip Resistor          | 1    | 1/10 W | 2.2 Ω  | RK73B1JTDD2R2J | KOA        | -       |
| R4   | Chip Resistor          | 1    | 1/10 W | 47 kΩ  | RK73B1ETTP473J | KOA        | -       |
| R5   | Chip Resistor          | 1    | 1/10 W | 68 Ω   | RK73B1JTDD680J | KOA        | -       |
| R6   | Chip Resistor          | 1    | 1/10 W | 2.2 Ω  | RK73B1JTDD2R2J | KOA        | -       |
| R7   | Chip Resistor          | 1    | 1/10 W | 47 kΩ  | RK73B1ETTP473J | KOA        | -       |
| R8   | Chip Resistor          | 1    | 1/10 W | 68 Ω   | RK73B1JTDD680J | KOA        | -       |
| R9   | Chip Resistor          | 1    | 1/10 W | 2.2 Ω  | RK73B1JTDD2R2J | KOA        | -       |
| R10  | Chip Resistor          | 1    | 1/10 W | 47 kΩ  | RK73B1ETTP473J | KOA        | -       |
| R11  | Chip Resistor          | 1    | 1/10 W | 68 Ω   | RK73B1JTDD680J | KOA        | -       |
| R12  | Chip Resistor          | 1    | 1/10 W | 2.2 Ω  | RK73B1JTDD2R2J | KOA        | -       |
| R13  | Chip Resistor          | 1    | 1/10 W | 47 kΩ  | RK73B1ETTP473J | KOA        | -       |
| R14  | Chip Resistor          | 1    | 1/10 W | 68 Ω   | RK73B1JTDD680J | KOA        | -       |
| R15  | Chip Resistor          | 1    | 1/10 W | 2.2 Ω  | RK73B1JTDD2R2J | KOA        | -       |
| R16  | Chip Resistor          | 1    | 1/10 W | 47 kΩ  | RK73B1ETTP473J | KOA        | -       |
| R17  | Chip Resistor          | 1    | 1/10 W | 68 Ω   | RK73B1JTDD680J | KOA        | -       |
| R18  | Chip Resistor          | 1    | 1/10 W | 2.2 Ω  | RK73B1JTDD2R2J | KOA        | -       |
| CN1  | Screw Terminal         | 2    | -      | -      | OT-046A        | OSADA      | -       |
| CN2  | Screw Terminal         | 3    | -      | -      | OT-046A        | OSADA      | -       |
| CN3  | Board Terminal         | 1    | -      | -      | HTS-2511-02P   | HIROSUGI   | -       |
| CN4  | Board Terminal         | 1    | -      | -      | HTS-2511-06P   | HIROSUGI   | -       |

## Evaluation Method

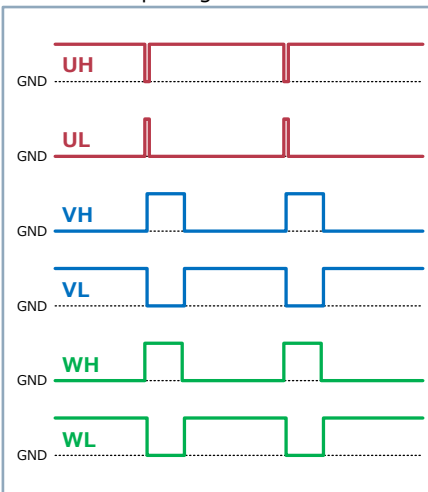


## Complementary PWM control

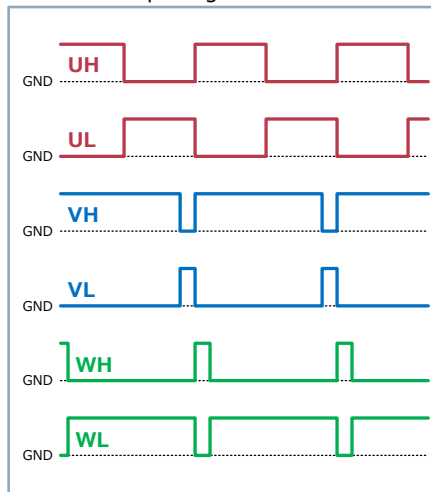
Phase current frequency : 50Hz



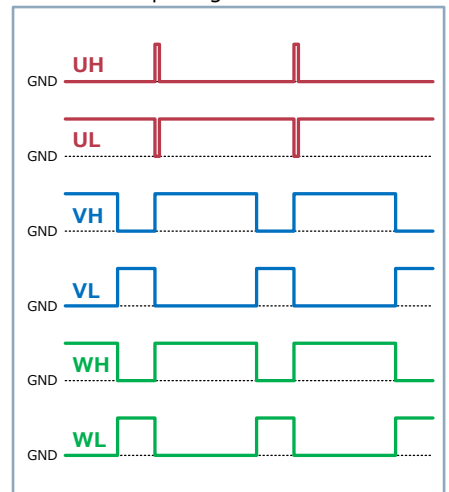
1. Point A Input signal waveform



2. Point B Input signal waveform



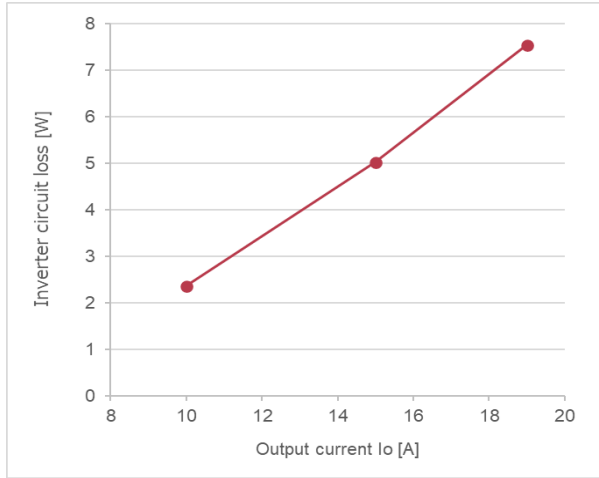
3. Point C Input signal waveform



Carrier frequency : 20kHz

## Inverter circuit loss

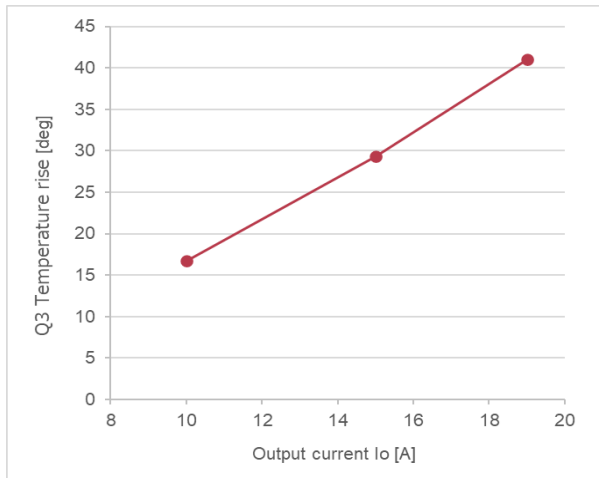
$V_{in}=12V$ ,  $V_{cc}=12V$ , Phase current frequency:50Hz, Carrier frequency:20kHz



| Output current<br>$I_o$ [A] | Input power<br>$P_{in}$ [W] | Output power<br>$P_o$ [W] | Inverter circuit loss<br>[W] |
|-----------------------------|-----------------------------|---------------------------|------------------------------|
| 10                          | 97.2                        | 94.9                      | 2.36                         |
| 15                          | 144.8                       | 139.7                     | 5.02                         |
| 19                          | 182.5                       | 174.9                     | 7.54                         |

## Temperature

Temperature evaluation is measured at room temperature using a thermoviewer.  
 $V_{in}=12V$ ,  $V_{cc}=12V$ , Phase current frequency:50Hz, Carrier frequency:20kHz

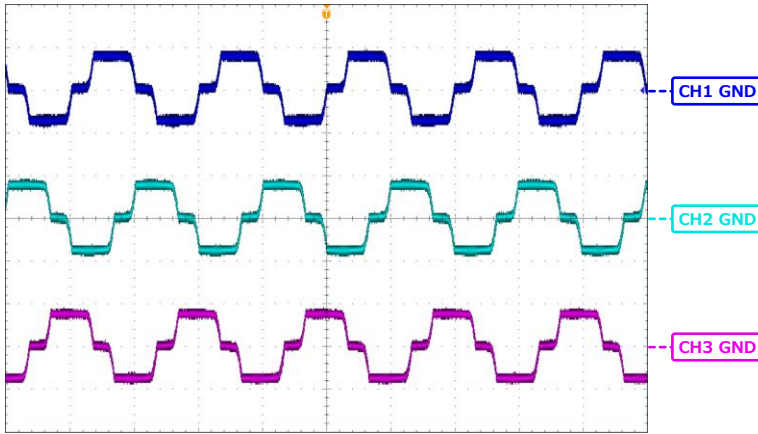


| Output current<br>$I_o$ [A] | Q3 (MOSFET)                       |                                   |
|-----------------------------|-----------------------------------|-----------------------------------|
|                             | Max. measurement temperature [°C] | Temperature rise $\Delta T$ [deg] |
| 10                          | 45.2                              | 16.7                              |
| 15                          | 58.3                              | 29.3                              |
| 19                          | 70.7                              | 41                                |

**Operation waveform**

**Photo.1 Phase Current waveform**

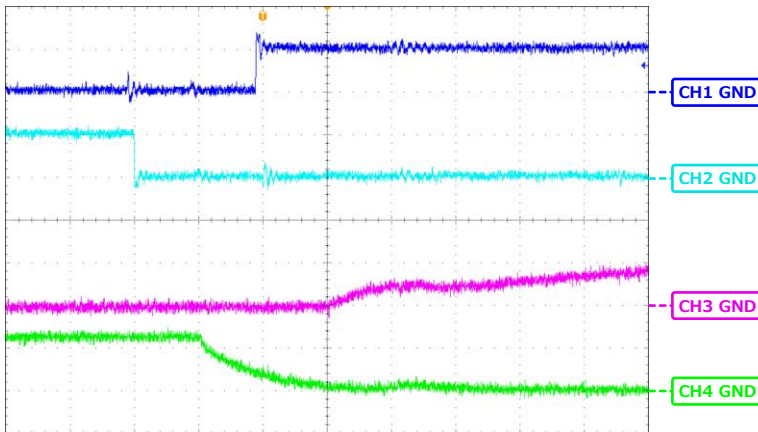
Vin=DC 12V / Io=19A



|      |                   |            |
|------|-------------------|------------|
| CH1  | : U-Phase Current | 25A/div    |
| CH2  | : V-Phase Current | 25A/div    |
| CH3  | : W-Phase Current | 25A/div    |
| Time |                   | : 10ms/div |

**Photo.2 Input Signal Dead Time waveform 1**

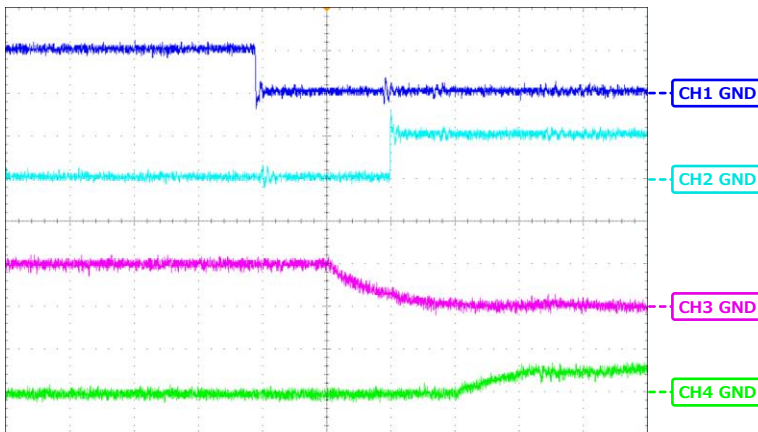
Vin=DC 12V / Io=19A



|      |        |             |
|------|--------|-------------|
| CH1  | : UH   | 5V/div      |
| CH2  | : UL   | 5V/div      |
| CH3  | : G_UH | 10V/div     |
| CH4  | : G_UL | 10V/div     |
| Time |        | : 200ns/div |

**Photo.3 Input Signal Dead Time waveform 1**

Vin=DC 12V / Io=19A



|      |        |             |
|------|--------|-------------|
| CH1  | : UH   | 5V/div      |
| CH2  | : UL   | 5V/div      |
| CH3  | : G_UH | 10V/div     |
| CH4  | : G_UL | 10V/div     |
| Time |        | : 200ns/div |