Slim Plug-In Arithmetic Operation Unit with Isolated Single/Dual Output

DESCRIPTION

The MS3765 is a slim, plug-in arithmetic operation unit that receives two DC current or voltage signals and outputs a signal proportional to the result (sum, difference, product, or quotient) of an arithmetic operation (addition, subtraction, multiplication, or division). The unit provides isolated single or dual output.

ORDERING CODE

MS3765 - □ - □ □ □ □

Model

Power Supply
- **A**: 100 to 240V AC (50 to 60Hz)
- **D**: 24V DC
- **P**: 100 to 240V DC

Input 1
- **A**: 4 to 20mA DC
- **B**: 2 to 10mA DC
- **C**: 1 to 5mA DC
- **D**: 0 to 20mA DC
- **E**: 4 to 20mA DC *1
- **H**: 10 to 50mA DC
- **Z**: Other DC current signal
- **3**: 0 to 1V DC
- **4**: 0 to 10V DC
- **5**: 0 to 5V DC
- **6**: 1 to 5V DC
- **4W**: ±10V DC
- **5W**: ±5V DC
- **0**: Other DC voltage signal

*1: Shunt resistor 50Ω

Input 2

The codes are the same as for Input 1.

Output 1
- **A**: 4 to 20mA DC
- **D**: 0 to 20mA DC
- **Z**: Other DC current signal
- **1**: 0 to 10mV DC
- **2**: 0 to 100mV DC
- **3**: 0 to 1V DC
- **4**: 0 to 10V DC
- **5**: 0 to 5V DC
- **6**: 1 to 5V DC
- **3W**: ±1V DC
- **4W**: ±10V DC
- **5W**: ±5V DC
- **0**: Other DC voltage signal

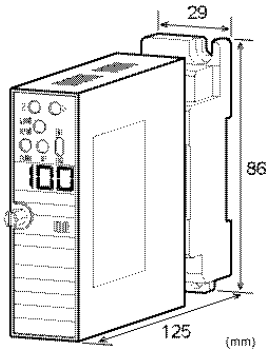
Output 2
- **No code**: None

The codes are the same as for Output 1

Note 1: When a voltage output is selected for Output 1, a current output cannot be selected for Output 2.
Note 2: When the code A (4 to 20mA) is selected for both of the two outputs, the output load will be 550Ω maximum for Output 1 and d 350Ω maximum for Output 2.

Options
- **No code**: None
- **/L**: Dual current output with high output load (OUT-1: 750Ω / OUT-2: 550Ω)
- **/X**: Others (Special order)

* For non-standard options, ask MTT for availability.



ORDERING INFORMATION

To place an order, please use the ordering code format as shown on the left.
(e.g.) MS3765-A-66A

* Default settings: Addition, K1 = 1.0, K2 = 1.0

Other Ordering Examples:
For an input code of "0": MS3765-A-0AA (Input: 0.2 to 1V)
For an output code of "Z": MS3765-A-A6Z (Output: 8 to 20mA)
For specific settings (Type of arithmetic operation / Input-1 factor / Input-2 factor): MS3765-A-66A (Subtraction / K1 = 2.0 / K2 = 2.0)
Note: If you wish to include multiple options in your order, specify the option codes in series (e.g. /LX).

SPECIFICATIONS

●POWER SECTION

Power Requirements	100 to 240V AC: 85 to 264V AC (47 to 63Hz) 24V DC: 24V DC±10% 100 to 240V DC: 85 to 264V DC		
Power Sensitivity	Better than ±0.1% of span for each power supply range.		
Power Line Fuse	160mA fuse is installed (standard).		
Power Consumption			
Power	100-240V AC	24V DC	100-240V DC
Single Output	6.0VA max	1.7W max	6.0W max
Dual Output	6.5VA max	2.1W max	7.2W max

●INPUT SECTION

Input Resistance		
Voltage Input (DC)	With or without power: 1MΩ min.	
Current Input (DC)	4 to 20mA (std.)	250Ω
	2 to 10mA	250Ω
	1 to 5mA	100Ω
	0 to 20mA	250Ω
	10 to 50mA	10Ω
Allowable Input Voltage		
Voltage Input Model	30V DC max., continuous (for a span up to 10V)	
Current Input Model	40mA DC max., continuous (for 4 to 20mA)	
Input Range	0 to 120%	

Ranges Available

	Current Signal	Voltage Signal
Input Range (DC)	-100 to 100mA	-300 to 300V
Input Span (DC)	100μA[*1] to 200mA	200mV[*2] to 600V
Input Bias	-100 to 100%	-100 to 100%

Note: For any input range including negative input signals, the input spans for current and voltage signals range from [*1]200μA to 200mA and [*2]400mV to 600V, respectively.

Input Spec. Ex.1: For 3 to 8V input, the input span is 5V and the bias +60%.

Input Spec. Ex. 2: For -5 to 0V input, the input span is 5V and the bias -100%.

●OUTPUT SECTION

Allowable Output Load

Voltage Output (DC)	1V span and up	2mA max.
	10mV	10kΩ min.
	100mV	100kΩ min.
Current Output (DC)	4-20mA single output	750Ω max.
	4-20mA dual output	Output 1: 550Ω max. Output 2: 350Ω max.

Zero Adjustment	Approx. ±5% of span. (Adjustable by the front-accessible trimmer.)
Span Adjustment	Approx. ±5% of span. (Adjustable by the front-accessible trimmer.)
Output Range	0 to approx. 120%

Ranges Available

	Current Signal	Voltage Signal
Output Range (DC)	0 to 20mA	-10 to 10V
Output Span (DC)	4 to 20mA	10mV to 20V
Output Bias	0 to 100%	-100 to 100%

* For current output signals, the accuracy of any current output smaller than 0.1mA is not guaranteed.

Output Spec Ex. 1: For 4 to 20mA output, the output span is 16mA and the bias +25%.

Output Spec Ex. 2: For -1 to 4V output, the output span is 5V and the bias -20%.

●PERFORMANCE

Equations

Addition	Y = (IN1 × K1) + (IN2 × K2)
Subtraction	Y = (IN1 × K1) – (IN2 × K2)
Multiplication	Y = (IN1 × K1) × (IN2 × K2)
Division	Y = (IN1 × K1) / (IN2 × K2)

Where
Y: Output (%)
K1: Input-1 factor, K2: Input-2 factor
IN1: Input 1 (%), IN2: Input 2 (%)

Factor Setting Range

The factors K1 and K2 should be set in steps of 0.01 within the following respective ranges.

Addition	K1 = 0.10 to 2.00 K2 = 0.10 to 2.00 (K1 + K2 ≥ 0.40)
Subtraction	K1 = 0.40 to 2.00 K2 = 0.10 to 2.00
Multiplication	K1 = 0.20 to 2.00 K2 = 0.20 to 2.00 (0.4 ≤ K1 × K2 ≤ 2.00)
Division	K1 = 0.10 to 2.00 K2 = 0.10 to 2.00 (0.4 ≤ K1/K2 ≤ 2.00)

Accuracy Rating	(at 25±5°C)
Addition	If K1 ≤ 1.00 and K2 ≤ 1.00: Better than ±0.2% of span. If K1 > 1.00 or K2 > 1.00: Better than ±0.4% of span.
Subtraction	If K1 ≤ 1.00 and K2 ≤ 1.00: Better than ±0.2% of span. If K1 > 1.00 or K2 > 1.00: Better than ±0.4% of span.
Multiplication	If K1 × K2 ≤ 1.00: Better than ±0.2% of span. If K1 × K2 > 1.00: Better than ±0.4% of span.
Division	If K1/K2 ≤ 1.00: Better than ±1.0% of span. (IN2 ≥ 20%) If K1/K2 > 1.00: Better than ±2.0% of span. (IN2 ≥ 20%)
Temperature Effect	Better than ±0.15% of span per 10°C change in ambient.
Response Time	150ms max. (0 to 90%) with a step input at 100%.
Factor Indicator	Red LED, digit height 8.0mm, 3 digits.
CMRR	100dB min. (500V AC, 50/60Hz)
Isolation	Isolation between input, output [Output 1, Output 2], power, and ground.
Insulation Resistance	100MΩ min. (@ 500V DC) between input, output [Output 1, Output 2], power, and ground.
Dielectric Strength	Input / Output [Output 1, Output 2] / [Power, Ground]: 2000V AC for 1 minute (Cutoff current: 0.5mA) Power / Ground: 2000V AC for 1 minute (Cutoff current: 5mA) Output 1 / Output 2: 500V AC for 1 minute (Cutoff current: 0.5mA)
Surge Withstand Capability	Tested as per ANSI/IEEE C37.90.1-1989
Operating Environment	Ambient temperature: -5 to 55°C Humidity: 5 to 90% RH (non-condensing)
Storage Temperature	-10 to 60°C

●PHYSICAL

Installation	Wall/DIN rail mounting
Wiring	M3.5 screw terminal connection (with a power terminal block cover & drop-proof screws)
Screwing Torque	0.8 to 1.0 [Nm] * Recommended
External Dimensions	W29 × H86 × D125mm (including the mounting screw and socket)
Weight	Main unit: 130g max. Socket: 80g max.

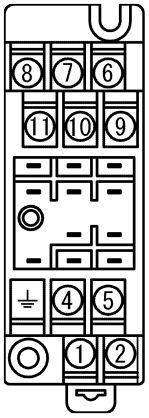
●MATERIALS

Housing	ABS resin (UL 94V-0)
Terminal Block	PBT resin (UL 94V-0)
Terminal Block Cover	PC resin (UL 94V-2)
DIN Rail Stopper	PP resin (UL 94HB)
Screw Terminal	Nickel-plated steel
Contacts Material and Finish	Brass with 0.2μm gold plating

Printed Circuit Board	Glass fabric epoxy resin (FR-4: UL 94V-0)
Conformal Coating	HumiSeal® 1A27NSLU (Polyurethane)

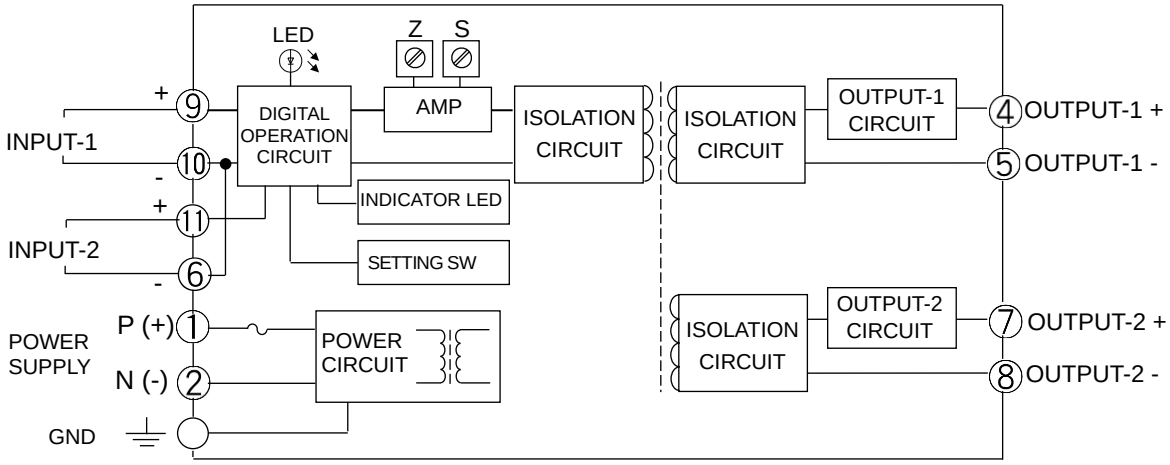
* HumiSeal® is a registered trademark of Chase Corporation.

TERMINAL ASSIGNMENT

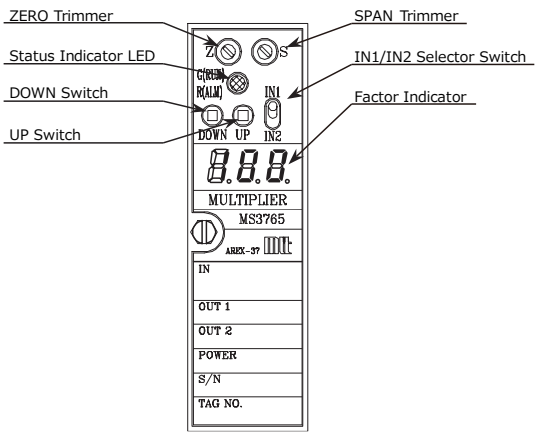


①	P (+) POWER
②	N (-)
⏚	GND
④	+ OUTPUT 1
⑤	- OUTPUT 1
⑥	- INPUT 2
⑦	+ OUTPUT 2
⑧	- OUTPUT 2
⑨	+ INPUT 1
⑩	- INPUT 1
⑪	+ INPUT 2

BLOCK DIAGRAM



FRONT VIEW



SETTING

●EQUATION SETTING

Setting Procedure

Setting an equation requires the following steps:

1. Turn on the power while pressing the DOWN Switch.
2. The Status Indicator LED will blink alternately red and green with the Factor Indicator off. Then, release the DOWN Switch within five seconds.
3. Any of the numbers 1 through 4 will appear only in the middle digit of the Factor Indicator except for the following cases. In such cases, you should try again from the beginning.
   - The Status Indicator LED did not repeatedly light red and green after the power is turned on.
   - The DOWN Switch was pressed and held for more than five seconds.

4. The number (arithmetic operation code) displayed represents the currently selected equation. Use the UP or DOWN Switch to change the equation. The arithmetic operation codes and corresponding equations are as shown below.

Arithmetic Operation Code	Equation	
1	Addition	Y = (IN1 × K1) + (IN2 × K2)
2	Subtraction	Y = (IN1 × K1) – (IN2 × K2)
3	Multiplication	Y = (IN1 × K1) × (IN2 × K2)
4	Division	Y = (IN1 × K1) / (IN2 × K2)

5. After selecting the arithmetic operation code, set the IN1/IN2 Selector Switch to the opposite position to where it is located so that the selected code will be saved in the unit.
   Note: Failure to do this will prevent the code from being saved.
   Immediately after the IN1/IN2 Selector Switch is operated, the Factor Indicator will be off for approx. 0.5 second.
6. Turn the power off and on again, and the unit will start its operation according to the set equation.

Factory Default Setting

If not specified, the arithmetic operation will be set to the factory default, “addition”.

●FACTOR SETTING

Setting Procedure

When the IN1/IN2 Selector Switch is set to the IN1 position, the Factor Indicator shows the current IN1 factor. This factor value can be changed to a desired value by pressing the UP/DOWN switch.
When the IN1/IN2 Selector Switch is set to the IN2 position, the Factor Indicator shows the current IN2 factor. This factor value can be changed to a desired value by pressing the UP/DOWN switch.
The set factors will be separately saved for each equation.

Indicator

The Factor Indicator goes OFF if no switch is operated for one minute.

UP/DOWN Switch

The switch is of a push button type. Pressing and holding the switch increases the speed at which the value changes.

Factory Default Setting

If not specified, the IN1 and IN2 factors will be both set to the factory default, 1.00.

LED STATUS INDICATOR

●INDICATOR PATTERNS

No.	Event	Factor Indicator (7-segment LED)	Status Indicator LED	Output	Recovery Operation
1	Power ON or switch operation	Blinks 3 times (1 s ON - 0.5 s OFF cycle), then displays an arithmetic operation code for 1 second.	Green LED turns ON for 1 second and then red LED turns ON for 0.5 second. This cycle is repeated 3 times, followed by green LED lighting for 1 second.	Normal	–
2	Normal operation	OFF	Green LED is ON.	Normal	–
3	Factor setting	Set value	Green LED is ON.	Normal	–
4	DAC error	Error code: 01	Red LED blinks at 0.25 second intervals.	Typically 0%, but may vary.	None
5	ADC compensated value error	Error code: 02	Red LED blinks at 1 second intervals.	0%	None
6	Arithmetic operation mode setting error	Error code: 04	Red LED blinks at 1 second intervals.	0%	Reconfig-uration
7	Input factor error	Error code: 08	Red LED blinks at 1 second intervals.	0%	Reconfig-uration
8	System error	Not defined.	Red LED is ON; Green LED is not defined.	Typically 0%, but may vary.	None

Notes:
No. 1: When the Factor Indicator is ON, a 3-digit number “888” with dots is displayed.
No. 4 -7: Only the last two digits are displayed in the event of an error.
No. 8: The red LED sometimes fails to light up.