# Genuine Signal Reports with Copyability and Strength

Signal reporting is pretty much of a ritual in Amateur Radio. Even a short, friendly QSO usually includes a signal report early in the exchange. A number of contests – but not all of them by any means – include so-called "signal reports" as part of a required exchange. Radio amateurs are experimenters. We might be trying out a new mode, a new antenna, a new transceiver, and we often play around with different power levels. Genuine signal reports are much easier with the new CS or Copyability and Strength system than with the familiar RST. RST is purely descriptive: it includes no quantitative information except for ranked categories.

## Signal Readability in RST

The **R** part of RST consists of five numbers denoting different degrees of readability. All of the distinctions are useful. There are significant differences among those five levels. On the low end, the difference between "unreadable" and "barely readable, occasional words distinguishable" is helpful. At the top end, the distinction in RST **R** levels 4 and 5 conveys a minor difference between "readable with practically no difficulty" and "perfectly readable."

Nevertheless, most of us get uncomfortable if we receive an **R** report of 4 rather than 5. We shouldn't. That is, we shouldn't worry if we know that the other operator really understands RST and is actually telling us that our signals are "readable with practically no difficulty." If so, we don't need to adjust the beam. We don't need to increase the output power. We don't need to speak closer to the microphone or enunciate more clearly or use wider word spacing in Morse. The other operator is experiencing "practically no difficulty" in understanding us. We tend to hand out RST R-5 reports far more often than we should. "Perfectly readable" signals are common enough, but signals which are "readable with practically no difficulty" occur much more frequently.

If we receive an R report of 3, however, we need to take note. Our transmissions are "readable with considerable difficulty." There is a huge gulf between level 3, "readable with considerable difficulty" and level 4, "readable with practically no difficulty."

The five levels of readability in RST are not enough to give us an accurate picture of the readability of our signals. I am not seriously suggesting that we set out to improve RST. Its problems are too significant for that, but if we were going to continue using RST, at least one more level between 3 and 4 would improve the R parameter:

# Genuine Signal Reports with Copyability and Strength

**1 – Unreadable**
**2 – Barely readable, occasional words distinguishable**
**3 – Readable with considerable difficulty**
**4 – Readable with some difficulty**
**5 – Readable with practically no difficulty**
**6 – Perfectly readable**

## Signal Strength in Official RST

**1 – Faint signals, barely perceptible**
**2 – Very weak signals**
**3 – Weak signals**
**4 – Fair signals**
**5 – Fairly good signals**
**6 – Good signals**
**7 – Moderately strong signals**
**8 – Strong signals**
**9 – Extremely strong signals**

The nine levels of the RST Signal Strength scale is a pretty good list.[1] Some people may quibble about the language of 4, 5 and 6, but the progression is clear and it does give scope for useful **S** reports. RST has three levels in the "strong signal" category: moderately strong, strong and extremely strong. Let's think about that "extremely strong signals" level, 9 on the RST signal strength scale. In order to grasp the meaning of "extremely" take a look at the ITU Radio Bands classification system:

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[1] The list is already expanded. In 1934 the RST Signal Strength scale included only five levels:
**1 – Faint – signals barely perceptible**
**2 – Weak signals**
**3 – Fairly good signals**
**4 – Good signals**
**5 – Very strong signals**
**QST** November 1934, p. 72

# Genuine Signal Reports with Copyability and Strength

## International Telecommunications Union (ITU) Radio Bands

3 Hz to 30 Hz = **Extremely** **L**ow **F**requency
30 Hz to 300 Hz = **S**uper **L**ow **F**requency
300 Hz to 3 kHz = **U**ltra **L**ow **F**requency
3 kHz to 30 kHz = **V**ery **L**ow **F**requency
30 kHz to 300 kHz = **L**ow **F**requency
300 kHz to 3 MHz = **M**iddle **F**requency
3 MHz to 30 MHz = **H**igh **F**requency
30 MHz to 300 MHz = **V**ery **H**igh **F**requency
300 MHz to 3 GHz = **U**ltra **H**igh **F**requency
3 GHz to 30 GHz = **S**uper **H**igh **F**requency
30 GHz to 300 GHz = **Extremely** **H**igh **F**requency

Middle Frequency (MF) is in the middle of a set of bands graded on a geometric scale by orders of magnitude. No amateur bands, including the new one at 630 meters which was allocated at the 2012 WRC-12 conference, fall below the Middle Frequency range. Low Frequency (LF) is just below the middle, and High Frequency (HF) is just above the middle. The bands above and below those three categories are designated by four different levels of superlatives: Very, Ultra, Super and Extremely. Those descriptors are the same going down and going up. **Extremely** Low Frequency and **Extremely** High Frequency are just that: extreme. They are outliers. They are beyond ordinary experience. Likewise, "**extremely** strong signals" are outliers. They are beyond our ordinary experience.

Many operators equate 9 on the RST **S** scale with the approximate equivalent of S-9 on the S-meter. Look at S-meter(s) on your transceiver(s). Where is S-9? Is it as high as half-way up the S-meter scale, which is also geometric? Maybe it's below half-scale. Different S-meters are set differently, but a generally-agreed standard promulgated by the International Amateur Radio Union Region 1 [2] is to calibrate an S-meter so that a 50 □V signal at 50 □ impedance reads S-9. That's certainly not "extremely strong." The official language of RST says that a strength report of 9 for RST is extreme. Based on the standard wording of RST, an S-9 report in RST should be reserved for that next-block kilowatt station whose beam is pointed toward our antenna. If our S-meter reads only S-9, our RST signal strength report should be 5, or maybe 6 on a good day, never more than that, according to official RST.

[2] The IARU Region 1 covers countries in Africa, Europe, the Middle East and Northern Asia.

# Genuine Signal Reports with Copyability and Strength

The actual language of the signal strength portion of RST is ignored by many operators, even when they are trying to give "honest" reports. For DXing and contesting? That's a whole different can of worms. Stereotyped signal reports serve no useful communications purpose whatsoever.

## Signal Strength Scale in Unofficial RST

The official RST signal strength scale is complicated and tough to remember. When RST was invented, there was no such thing as an S-meter in amateur stations. When S-meters arrived, they were game-changers:


**Collins KWM-2**

The analog S-meter on the Collins KWM-2 is simple and elegant. S-9 is exactly mid-scale, and the maximum signal shown is a whopping 60 decibels over S-9. Most modern transceivers are equipped with analog or digital S meters. Some go as high as 60 dB over S-9. Others top out a bit lower. Here's what those values in decibels over S-9 actually mean:

# Genuine Signal Reports with Copyability and Strength

- **10 dB over S-9 is 10 ($10^1$) times more powerful than an already-respectable S-9 signal.**
- **20 dB over S-9 is 100 ($10^2$) times more powerful.**
- **30 dB over S-9 is 1000 ($10^3$) times more powerful.**
- **40 dB over S-9 is 10 000 ($10^4$) times more powerful.**
- **50 dB over S-9 is 100 000 ($10^5$) times more powerful.**
- **60 dB over S-9 is 1 000 000 ($10^6$) times more powerful.**

S-meters are helpful, since with an automatic AGC (automatic gain control) or ALC (automatic level control) commonly used on Amateur Radio rigs, very loud signals and moderately-loud signals sound about the same. Most S-meters are governed by the AGC or ALC control voltages. Since the lower part of the S-meter measures S-units 1 through 9, many operators began to ignore the official verbiage of the RST strength scale and substituted those S-units, like this:

## Unofficial RST Strength Scale

**1 – S-meter S-1**
**2 – S-meter S-2**
**3 – S-meter S-3**
**4 – S-meter S-4**
**5 – S-meter S-5**
**6 – S-meter S-6**
**7 – S-meter S-7**
**8 – S-meter S-8**
**9 – S-meter S-9**
**9 plus – more than S-meter S-9**

Although never sanctioned by any Amateur Radio organization, this unofficial strength scale rules the bands now when operators are actually trying to send real signal reports. This system works fine as far as it goes, but since it doesn't take into account the number of decibels over S-9 which real S-meters measure, the unofficial scale isn't accurate.

# Genuine Signal Reports with Copyability and Strength

## Tone in RST

**1 – Sixty-cycle ac or less, very rough and broad**
**2 – Very rough ac, very harsh and broad**
**3 – Rough ac tone, rectified but not filtered**
**4 – Rough note, some trace of filtering**
**5 – Filtered rectified ac but strongly ripple-modulated**
**6 – Filtered tone, definite trace of ripple modulation**
**7 – Near pure tone, trace of ripple modulation**
**8 – Near perfect tone, slight trace of modulation**
**9 – Perfect tone, no trace of ripple or modulation of any kind**

The tone part of RST is a whole different story. Look at the nine-level description. Talk about a solution looking for a problem! Tone in RST is all about power supply problems. Back in the day of the transition from spark to CW, amateurs often had to build their own power supplies from scratch. AC products in transmitted signals were a significant problem then. When was the last time you heard a signal with a "rough note, some trace of filtering" or some such description? A sign of how little attention is actually paid to the tone part of RST is the fact that T-1 is still defined as **<Sixty-cycle ac or less, very rough and broad>**. The terminology hasn't even been updated to read 60 hertz! It doesn't refer specifically to signals originating from the many places in the world where commercial power is transmitted at 50 hertz.

Signals with AC products are not completely unknown today, but they certainly are not common enough to merit a nine-level scale in every CW or other digital-mode signal report. That fact was implicitly recognized when by the time that phone modes became common in Amateur Radio, the T part of RST was dropped for those modes. Other quality problems for phone modes, overmodulation for amplitude-modulated signals and overdeviation for frequency-modulated signals, were not addressed by the RS(T) system. Most of our three-character RST reports end properly with a T-9 tone report.

## Optional Suffixes in RST

The suffixes which are listed for RST do address the quality of signals. Chirpy signals and key clicks are still heard from some CW stations. The C and K suffixes telegraph those problems for CW, but the RST suffixes don't treat quality

problems in digital and phone modes. The optional X suffix is a fine compliment. Its absence implies the same thing: There are no quality problems to report.

## Genuine Signal Reporting

If we want to receive accurate reports for our radio signals, we need answers to three questions:

1) How much of our transmission can the other operator copy?
2) How strong is our transmission?
3) Does our transmission have any quality problems?

CS or Copyability and Strength with optional suffixes answers those three questions. It was first published in the February 2012 issue of QST (page 77).

# Genuine Signal Reports with Copyability and Strength

## Copyability and Strength or CS

### C or Copyability Scale

N = no recoverable signal*
0 = discernible but not copyable*
1 = 10 % copy
2 = 20 % copy
3 = 30 % copy
4 = 40 % copy
5 = 50 % copy
6 = 60 % copy
7 = 70 % copy
8 = 80 % copy
9 = 90 % copy
G = Good 100 % copy, but short of perfect
P = Perfect armchair 100 % copy or full-quieting on FM

### S or Signal Strength Scale

0 = no S-meter reading
1 = S-1
2 = S-2
3 = S-3
4 = S-4
5 = S-5
6 = S-6
7 = S-7
8 = S-8
9 = S-9
A = 10 dB over S-9
B = 20 dB over S-9
C = 30 dB over S-9
D = 40 dB over S-9
E = 50 dB over S-9
F = 60 dB or more over S-9

**Optional Quality Suffixes**

C = **C**hirp or tail on make and/or break
K = key clic**K**s or other **K**eying transients
O = **O**vermodulation or **O**verdeviation in phone or digital modes
R = AC **R**ipple or buzz in transmission
X = characteristic steadiness of crystal (**X**tal) control or e**X**cellent quality

* For Copyability reports of N or 0, no Signal Strength report is needed.





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# Genuine Signal Reports with Copyability and Strength

The CS system does a much better job than RS(T) of telling the real story about our signals in a very brief format, normally consisting of two characters:

- **On phone: "Your CS is papa seven [P7]." That's a perfectly-copyable S-7 signal. Excellent quality is implied with no suffix. The suffix X could optionally be added, just as in the case of RS(T).**
- **On CW: "CS GA" for good 100 % copy at 10 dB over S-9, or "CS 74K" for 70 % copyability at S-4 signal strength with key clicks.**
- **On PSK-31: "CS G3O" for good 100 % copy at S-3, but overdeviated.**

## Signal Copyability in CS

Way back in 1925, when RST was in its infancy, the American **QST** magazine reported a percentage "readability" proposal:

> **E. G. Watts of 4FM makes a very good suggestion regarding an addition to the present R system of stating audibilities. The present "R9" signal only indicates a very loud signal---it may be audible all over the shack but if there is any great amount of QRN or streetcar QRM or induction the *readability* may be way down. Why not add to the signal strength "R" signal to indicate percent readability, thusly: 9 is 100%, 8-80%, 7-70%, 6-60%, and so on.**[3]

E. G. Watts' proposal didn't catch on then. Maybe that was because designating 100 % with a 9 and then skipping to 80 % with an 8 is awkward. CS borrows E. G. Watts' idea, but fixes that glitch.

At the lower end, CS makes a distinction between "no recoverable signal" (N) and "discernible but not copyable" (**Ø**). The numerical digits from 1 through 9 designate 10 % through 90 % copyability. That's straightforward and very easy to remember. In practice, operators often distinguish between a signal which is just 100 % copyable and one which is not only 100 % copyable, but at an "armchair" or "full-quieting" level. CS calls the first "G" for **Good**. Copyability of "G" in CS is the equivalent of R-4 in RST. The second is "P" for **Perfect**, the exact equivalent of R-5 in RST. The five levels of readability in RST, as we've seen, are too sparse for very useful characterization, and since in RST that parameter consists of non-quantitative verbiage, it's hard to remember the details.

In some cases with manually-operated stations, it may be difficult to estimate the percentage of copyability within a resolution of 10 %, but as computer-aided operation becomes more common, we may be able to obtain real copyability measurements even finer than a 10 % resolution. The Copyability parameter of CS may thereby become automated.

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[3] **QST** October 1925, p. 36

# Genuine Signal Reports with Copyability and Strength

## C in CS Compared to R in RST

**C-N = no recoverable signal □ R-1 – Unreadable**
**C-Ø = discernible but not copyable □ R-2 – Barely readable, occasional words distinguishable**
**C-1 to C-9 = 10 % to 90 % copy ≈ R-3 – Readable with considerable difficulty**
**C-G = Good 100 % copy, but short of perfect □ R-4 – Readable with practically no difficulty**
**C-P = Perfect armchair 100 % copy or full-quieting on FM □ R-5 – Perfectly readable**

Note: □ means <is comparable to>; ≈ means <is approximately equal to>.

## Signal Strength in CS

To report signal strength, CS uses S-meter readings. We all know about S-meter variations. We're radio amateurs with practical communications equipment. Most of us don't have fine-tolerance lab equipment in our stations. Although a 50 □V signal with a 50 □ input impedance is an emerging standard for S-9 on HF S-meters, not all S-meters are calibrated that way. There is variation in receiver sensitivity, and of course our antennas differ considerably. Nevertheless, this is no longer the early 20th century when S-meters didn't exist, and S-meters, no matter how they are calibrated, cover many orders of magnitude of signal strengths, so those differences are not very significant. Most of us now operate transceivers equipped with S-meters. Using them is the reasonable way for most hams to report signal strength.

Unlike with RST, we can properly use the numbers 1 through 9 to designate S-1 through S-9 signal strength in CS. For signals stronger than S-9, we can report so many decibels above S-9 using the letters A through F. At the very top of the scale, a signal which is at least 60 decibels over S-9 is indicated by the letter F, actually the number fifteen in hexadecimal notation. Remember that the 60-decibel level is 1 000 000 times more powerful than S-9. We report signal-strength values at that magnitude very rarely, indeed. To send the maximum CS report of PF routinely is laughably absurd.

## Optional Quality Suffixes in CS

CS borrows three optional suffixes directly from RST: C, K and X. The quality-reporting system in RST has one major flaw: there is no way within RST to report overmodulation or overdeviation in non-CW modes. CS remedies that

by employing a single letter **O** to alert an operator about those problems. Similarly, the **tone** parameter in RST has been eliminated in CS, since it is mostly irrelevant. For those rare cases when AC power supply products appear in the signals, the optional **R** suffix can be used to flag the issue, but not to characterize it with the nine levels of the tone report in RST.

## CS in Operation

CS is far simpler than RST. Unless optional suffixes are added, CS requires only two characters to make a complete report, yet it can apply to any common Amateur Radio mode. For signals with no quality problems, we only have to think about two items: **percentage copyability** and **S-meter reading**.

When should CS be used? CS, or any signal reporting system including RST, should be used only for routine contacts. Signal reporting, even if done accurately, doesn't enhance fast-paced operations like contests and DX pileups. Contest sponsors should re-evaluate exchanges which require signal reports. What purpose do they serve when they are almost always given in stereotyped forms? Both contesters and DXers need to send exchanges which are always the same in a given contest or DXpedition operation, or at least predictable in the case of contests with serial number exchanges. How about substituting other things like operator name or Maidenhead Field or year first licensed or whatever for contest exchanges? In some cases, the signal-report contest requirement can simply be dropped. It will not be missed and the QSO rates will increase.

Some amateurs believe that signal reports are a necessary component for a contact to be valid for Amateur Radio awards. That's a myth. ARRL and CQ Amateur Radio staff have confirmed that there is no such requirement for any awards which either organization administers.

Here is a list of contests which do not require signal reports in their exchanges:

- **All VHF/UHF Contests**
- **November Sweepstakes (ARRL)**
- **Field Day (ARRL)**
- **All ten 10-10 International QSO Parties**
- **North American Sprint (National Contest Journal)**
- **CW Mini-CWT Contests (CW Operators' Club)**
- **Northern California DX Club Mini-Sprints**
- **Rookie Roundup**
- **State QSO Parties for AZ, CA, CO, MD-DC, MI, MN, MT, NM, NC, OH, PA, SC, VA & WI**

# Genuine Signal Reports with Copyability and Strength

The same holds for DXpedition operations. Since bogus signal reports convey no useful information, they actually take up time and decrease QSO rates. Some DXpeditions may prefer to use only callsign exchanges. Should DXpeditioners wish to add information beyond callsigns, two-character Maidenhead Fields would be much more appropriate as DXpedition exchanges, since they can flag propagation changes and enable beam adjustments. Exchanging Maidenhead Fields can open up a whole new aspect of DXing, which has been formalized through the CQ DX Field Award.[4]

The following is an abbreviated summary of the CS Copyability Strength system which is suitable for mounting at the station position:

[4] Here are the details of the CQ Field Award:

**The CQ DX Field Award**

- **324 AA thru RR 2-character Maidenhead fields**
- **Includes sea as well as land locations**
  - **Basic award: 50 2-character fields**
    - **50 field endorsement for 3.5 MHz + 7 MHz combined**
    - **50 field endorsement for 28 MHz**
    - **25 fields each for 1.8 MHz, 50 MHz, 5 watts or less, mobile, SSTV & OSCAR endorsements**
  - **CQ DX Field Honor Roll: 175 fields or more**

**CQ Magazine April 2005, p. 26**

# Genuine Signal Reports with Copyability and Strength

## CS Compact Summary

### C or Copyability Scale

**N** = no recoverable signal*
**Ø** = discernible but not copyable*
**1-9** = 10 % to 90 % copy
**G** = Good 100 % copy, but short of perfect
**P** = Perfect armchair 100 % copy or full-quieting on FM

### S or Signal Strength Scale

**Ø** = no S-meter reading
**1-9** = S-1 to S-9
**A** = 10 dB over S-9
**B** = 20 dB over S-9
**C** = 30 dB over S-9
**D** = 40 dB over S-9
**E** = 50 dB over S-9
**F** = 60 dB or more over S-9

### Optional Quality Suffixes

**C** = **C**hirp or tail on make and/or break
**K** = key clic**K**s or other **K**eying transients
**O** = **O**vermodulation or **O**verdeviation in phone or digital modes
**R** = AC **R**ipple or buzz in transmission
**X** = characteristic steadiness of crystal (**X**tal) control or e**X**cellent quality

* For Copyability reports of N or 0, no Signal Strength report is needed.